CURE OF CLUB-FOOT.

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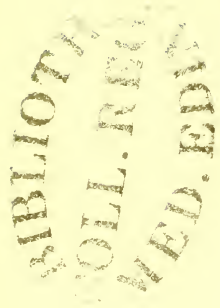
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Case of Mary A.

PLATE VII.

19th August, 1864.

PLATE VIII.

5th October.

PLATE IX.

19th October.

PLATE X.

31st May, 1865.

PLATE XI.

24th June.

PLATE XII.

24th June.

Talipes Varus.

To face Title.

ON THE

CURE OF CLUB-FOOT

WITHOUT CUTTING TENDONS;

AND ON CERTAIN

NEW METHODS OF TREATING OTHER DEFORMITIES.

BY

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PREFACE.

THE necessity for a Second Edition of a book must always be agreeable to an author; but the call for a further instalment of this work is especially pleasant music to my ears, for it is one of the many signs that the theory and practice invented and advocated by me have firmly taken root; while an increased area of experience enables me to speak with more confidence of a method of treatment which I have never found to fail, if proper perseverance be used. Nevertheless, it scarcely appears desirable to change or alter greatly the purport of my preface; as a history of my mental efforts in this direction, it must of necessity stand much the same.

The bare nucleus of the ensuing pages was introduced to the profession in 1861, by a Paper read before the Medico-Chirurgical Society,* entitled "On Certain Grave Evils resulting from Tenotomy; and on a New Method of Curing Deformities of the Foot." The history of its production is as follows :— From a very early period of my professional career I have paid much attention to joint diseases, and to methods of remedying lameness thereby produced. Among such cases lameness from other causes came frequently under my observation. I studied these maladies from the orthopædic point of view, and while tenotomy was still almost a novelty in England, was so charmed with the easy change of form, which after such an operation could be produced in most distortions, that I became an almost enthusiastic admirer of the procedure. After, however, following

* Published in the "Medico-Chirurgical Transactions," vol. xlv., p. 25.

up carefully a large number of these cases, I was pained to find in how many of them the deformity more or less returned; in how many more a different, an opposite distortion supervened; while power over the limb was actually injured or destroyed in so large a majority of instances, that its retention appeared absolutely exceptional.

About this time, while making, for the purpose of acquiring a sure power of tenotomy, an unusually careful dissection of the tendinous, fascial and ligamentous structures about the foot and ankle, I was struck by observing that the anatomical conditions of most tendons were much against the probability, even the possibility, of their free and unencumbered re-union. This fact, coupled with the sort of lameness produced by tenotomy, very much abated my predilection for the operation.

A further study, interrupted by other demands of practice, and resumed as occasion

might require, convinced me that Deformities of the Foot, the so-called *talipedes*, all primarily affect the front half of the limb, and that the mechanical and after-treatment of club-foot by shoes, all of which act primarily and principally on the ankle-joint, was manifestly ill adapted for the purpose in view. This fresh insight furnished the clue, which enabled me to discover the causes of the above-mentioned failures in treatment. I perceived, namely, that to fasten the sole, which ought to be mobile and free, upon a stiff iron, and to force the contracted muscles, *while at rest*, into a new posture, could only be a temporary remedy for the contraction, and must be an injurious or fatal augmentation of the paralysis, which is the "head and front of the offending."

From that time I tasked myself to find some means of exerting upon the part primarily and principally deformed (the anterior half of the tarsus) some force which, instead

of squeezing an inactive foot into, as it were, a moulded and inactive shape, should guide active but abnormal movement into its normal direction and relationship. The reader who follows out carefully and skilfully the procedures subsequently described, will judge how far I have failed or succeeded: the treatment is not represented as simple and easy; but for myself I can only say, that the more I see of deformities, the more reason have I to be satisfied with its results.

It would have been strange if my gradually-growing distrust of tenotomy had not influenced my practice in other cases besides in distortions of the feet. A former work,* in which, among other subjects connected with joint-disease, the "Restoration of Crippled Joints" is handled, had of course brought much additional means of experience in that particular branch; and I found myself more and more induced to refrain from dividing

* "A Treatise on Diseases of the Joints."

There only remains for me to add, that if in the course of the following work phrases have been used, which might appear somewhat severe, they will be, I hope, ascribed to my zeal for true principles, and not to any personal feeling. I combat a system—not men.

RICHARD BARWELL.

32, George Street, Hanover Square,
October, 1865.

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WITHOUT CUTTING TENDONS.

CHAPTER I.

INTRODUCTORY.

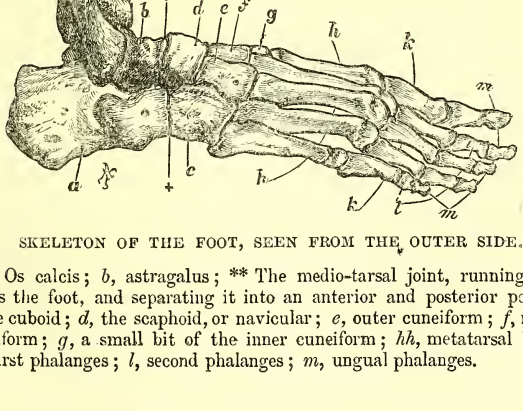
It does not come within the scope of the present work to consider the various theories concerning the origin of club-foot, nor to enter into its pathology, further than will be necessary to show why the present fashion of cutting the tendons is faulty in theory, and injurious in its consequences; why the shoes and other such instruments are false in design and construction; and why the plan of treatment which I have now carried on for some little time, both in hospital and in private practice, is founded in reason and satisfactory in result.

The foot, constructed as an instrument combining great strength with mobility, consists of twelve bones (besides those of the toes), all of which are united together by means of regularly-constructed joints. The whole mechanism is articulated to the leg by the talus or astragalus, which is received into the two leg bones at the ankle-joint, as a tenon is fixed into a mortoise. This articulation permits simply of extension and flexion, that is, of pointing or of turning up the toes; no other movement whatever, while the bones of the leg remain motionless, can take place in this joint. The action called turning the toes out or in is produced by rotation of the thigh and leg on the hip-joint when the knee is straight; but when the knee is bent that movement is effected by a revolving motion of the fibula acted on by the tensor vaginæ femoris and biceps muscles of the thigh; the anterior slip of the external lateral ligament being especially adapted to communicate this movement to the astragalus.

All other actions of the foot, such as turning the sole inwards or outwards, height-

ening or lowering the arch, &c., &c., take place in the joints among the eleven other bones of the limb. To each of these eleven bones one or more muscles are attached, having the office not only of producing movement, but also of keeping these parts in that position and relationship to each other, which constitutes the harmony and beauty of the exquisitely-constructed support. The heel-bone behind, and the metatarsus in front, form the buttress and flanks of an arch; the weight is placed over the hinder flank, that is,

FIG. I.



SKELETON OF THE FOOT, SEEN FROM THE OUTER SIDE.

a, Os calcis; *b*, astragalus; ** The medio-tarsal joint, running right across the foot, and separating it into an anterior and posterior portion; *c*, the cuboid; *d*, the scaphoid, or navicular; *e*, outer cuneiform; *f*, middle cuneiform; *g*, a small bit of the inner cuneiform; *hh*, metatarsal bones; *kk*, first phalanges; *l*, second phalanges; *m*, ungual phalanges.

over the first third of the whole distance between the heel and the root of the toes; the crown of the arch is formed by a number of small bones (cuboid, scaphoid, and three cuneiform bones), all so movably, yet so indissolubly jointed together, as to combine great flexibility with the necessary strength.

The arch of the foot has often been a subject of eulogium, but we are to observe that if it were a solid arch, like that of a bridge, such praise would be misplaced. Even granting any amount of flexibility, if the weight had been placed upon the middle, or at either end, the arciform build would have been of very little service. But the weight is placed over the solid hinder flank, giving the desirable stability to the posture, yet not so far back but that part of the burden is supported by, and with very little effort the whole can be thrown upon, the front flank of the arch. Thus we see that the solid hinder buttress is made for stationary strength, while the front one is adapted for buoyant movement. Indeed, man, having an instinctive feeling of this fact, plants his heel firmly on the ground

when about to raise a weight or resist a shock, but gets on the toe when starting for a race. The front of the foot could not, however, carry the body safely, if it were a single buttress with but one point of support like the heel; it is, on the contrary, much broader, and contains two points of support, one on each side, and between these a lateral arch is turned by the position of the tarsal and metatarsal bones. Thus is the elasticity of the limb still further secured.

Of all the joints in the front of the foot, the chief agent in its flexibility and security is one that runs across its whole breadth just in front of that part which supports the weight. It lies between the astragalus and os calcis behind, and the scaphoid and cuboid in front, and is very well named the medio-tarsal joint. It allows of flexion and extension, adduction and abduction, also rotation inwards and outwards upon the long axis of the foot. These movements are very important in a physiological point of view, therefore in a pathological and practical one for the subject now under consideration. We will first give

a little attention to the last of these movements. As the front of the foot rests on a broad base, or on two buttresses, it follows that when the ground slopes laterally this base must take the same direction. If the whole foot were obliged to follow this movement, there would result, as the body must be perpendicular, a necessity of continual and free lateral movement in the ankle ; but, such arrangement being incompatible with strength, the change of direction is, through the medium of the medio-tarsal joint, delegated to the front half of the foot. The formation of the extremity at this part is very different in different persons and at different times of life. A flat low arch is characteristic of the negro, and, to a certain extent, of the Jewish, foot. Infants habitually keep the outer side of the foot much lower than the inner side, so that the sole looks much more inward than is the case in the adult limb.* There is about the feet of most young girls and women a flexibility that is

* This infantile posture is, however, not merely produced by difference in the position of the medio-tarsal joint; it is also effected by greater inward rotation of the heel at the calcaneo-astragaloid joint.

quite remarkable. One may grasp the female foot, and holding the heel and ankle still, turn the front of it round till the sole looks almost directly inwards; although the other joints and although a twisting of the metatarsal bones help in such action, the great agent is the medio-tarsal articulation; the foot can also be curved laterally inwards till it is almost U shaped—and may be bent directly down and straightened up to a great extent; but it cannot normally be rotated much outwards, nor can it be bent laterally outwards. If we remember that the outside of the foot has two joints, between the os calcis and cuboid and between the cuboid and metatarsus; that the inside has four between the calx, astragalus, scaphoid, internal cuneiform, and metatarsus; if we consider that the inner part of the medio-tarsal joint is of the ball-and-socket description, the outer more mortoise-like, curving from above downwards; if we also remember the disposition of ligament, and particularly of the calcaneo-cuboid, we shall see why that one joint is much more immovable than the four inner tarsal joints. Then if

we observe, that as the foot is set down, the heel, the outward side of the sole, and the ball of the toes come to the ground, leaving all the inner side untouched, we shall not fail to perceive another example of that singular distribution of strength to one part and elasticity to the other, and to see why we can bend and twist the foot outwards hardly at all beyond its ordinary position.

These bones, admirably adapted as they are, would not for an instant keep their place unless supported and upheld by ligaments, muscles, and tendons. It is not my intention to describe the various parts; but there are one or two points which I must mention, because a great deal in treatment depends on a just knowledge of the architectural and dynamic anatomy of the extremity, and this has not, to my mind, been rightly understood. In the first place, the office of keeping up the longitudinal arch of the foot is ascribed to the plantar fascia: but fascia and ligaments are never placed as the guardians of position; this task is always confided to muscular structures. Moreover, the greatest amount of

curve is on the inside of the foot; therefore if the plantar fascia were the principal agent in keeping up the arch, its strongest part should be on the inside; but this is exactly the weakest part of the whole structure. Another very strong longitudinal ligament lying close to the bones, the calcaneo-cuboid, with its triple process to the three middle ossa metatarsi (ligamentum laciniatum) is on the outside of the foot. Even the muscles which run forward to the phalanges have but little influence on the curves of the tarsus, unless they have previously produced their full action on the toes. If, however, the construction of the foot be considered in conjunction with that of the leg, it will be observed that the tendon of the tibialis anticus muscle (which arises in the leg above the front of the foot) hooks round the os cuneiform, and is attached to its lower aspect and to the inner metatarsal bone, *i.e.*, to the highest point of the pedal arch. Thus we see that the construction is suspended to a sling, which, attached high above it, keeps up the key-stone, and thus the whole edifice; not by an immovable ligamentous tie; but by a

mobile force, which acts more or less, as the occasion may require.

It would be superfluous to enter into a description of the muscles and tendons of the leg and foot, with their various actions; my reason for the foregoing details is, that the error which I have signalized is of the greatest importance in a practical point of view, and leads to one among the disastrous errors in the fashionable treatment of pedal deformity. There are in my opinion many such false notions concerning this part of the body; they will be pointed out and corrected as we encounter them when treating of its morbid actions.

To every one of the bones of the foot, with the exception of the astragalus, one or more muscles are, as already said, attached, *i.e.*, either arise or are inserted; moreover, strong tendons glide through grooves in bones to which they are not otherwise attached, cross each other on the sole of the foot, where they become connected with other muscles whose very attachment therefore is movable, so that the limb as a whole, and in each particular, lies entirely under the dominion of muscular

force. It is to the even balance of power among the muscles, that the foot depends for its efficiency and form; for it is easy to perceive, that a slight preponderance or deficiency of power in one part or the other would throw a limb made up of so many nicely adjusted parts into some false form or position. And I must here point out that with the exception of the tendo Achilles, and a part of another cord, every tendon passing from the leg to the foot is inserted in front of the medio-tarsal joint; thus every muscular contraction (except that of the sural muscles, producing raising of the heel and slight inward rotation of the foot) acts primarily on the anterior half of the foot and medio-tarsal articulation, and only secondarily upon the back part and on the ankle-joint. This fact, which is most easily demonstrable on the feet of young people, is equally true, whether the direction of the action be antero-posterior, lateral, or rotatory, whether the action itself be physiological or pathological. The importance of this doctrine will, it is hoped, be clear in the sequel.

CHAPTER II.

DEFORMITIES OF THE FOOT, AND THEIR PROXIMATE CAUSES.

Children may, as is well known, either be born club-footed or the deformity may be acquired in after life. Many theories have been put forth to account for the congenital malady, many of them perfectly inconsistent with fact, invented in the dark to account for what takes place in obscurity. It appears to me, however, that rather than fly hap-hazard at some hypothesis, we shall be more likely to arrive at truth if we study, first, what conditions may produce acquired talipes, and then, while making all due allowance for change of circumstances, consider what similar conditions may produce *in utero*.

In following this route we may, by distin-

guishing two sorts of deformity utterly different in their conditions, very much diminish the amount of difficulty and confusion in which the subject has been involved. Deformity by fixed posture is simply unnatural persistence of some position in itself not abnormal. Deformity by mal-posture is persistence of some position, which is in itself abnormal. Let us first examine the former condition.

If a joint, as the elbow or the knee, be kept in splints or other artificial restraint for a number of days or weeks, the limb, when the bandages are removed, will be found stiffened; that is, there will be difficulty and pain in straightening or bending it; because all the ligaments and other fibrous tissues about the part will have hardened themselves into the position artificially maintained: but, moreover, there is a certain power inherent in muscle to adapt itself to the different postures of the bones to which they are attached. This power is not active contraction or muscular force, properly so called; it is a passive retraction, named "tonic," very similar to elasticity, and maintains, while the limb is at

rest, all its muscles in an equable balance of slight tension. If then a joint be artificially maintained in a certain position, *e.g.*, in flexion for a given period, the flexor muscle and the extensor will be equally tight, but in that posture the flexor is shortened and accustoms itself to that position; moreover, the cellular or areolar tissue, always a large constituent of muscle, becomes moulded to the degree of shortness which has been so long maintained. When, therefore, the limb is at length released, the muscular tissue proper, as well as all its investing and permeating fibrous material, resists extension; moreover, the extensor muscle kept so long stretched cannot readily retract.

The above statement will permit us easily to comprehend the cases of deformity by fixity of posture which arise after long splintage after long lying in some especial position, from chronic diseases, as fevers, &c.; also the frequent occurrence of retracted heel in cases of hip or knee disease, which having shortened the leg obliges the patient to walk constantly on the toes. Camper * relates

* Sur les Meilleures Espêces de Chaussures, p. 28.

that when, in obedience to fashion, our grandmothers abjured high-heeled shoes, they could not get the foot flat on the ground without considerable pain in the calf from stretching of the muscles in that region.*

In all these cases, however, it is to be observed that neither the muscle itself nor the motor nerve force is primarily in fault; on the contrary, the primary cause is something external, restraining muscular action. Even the few exceptional cases on record, in which an ulcer or diseased bone on one side of the foot has caused the patient to walk on the other part of the limb until a different gait became impossible, are still simply caused by external agency; moreover, the posture produced or assumed is never in itself unnatural, its fixity only is abnormal.

The cases of acquired club-foot, which it imports us now to study, are those in which the position is in itself abnormal, and the question is, how such gross malpostures can

* I have, in my work on Diseases of the Joints, explained this topic; and its pathology is more particularly insisted on in my Lectures on Hip Disease (*Lancet*, 1862-63).

be produced. We will leave out of the question the rare instances of distortion by absence or extreme development of a tarsal bone; but a few words must be said upon a supposed shortening of certain ligaments and fasciæ. We have just seen that fibrous tissues (ligamentous and fascious) will contract to fit any position long maintained, and this tendency is very much increased by rheumatic or gouty disease; but even in those maladies, be it remembered, the limbs are kept much at rest; moreover, an injury, especially a burn by fire or chemical agents, will cause such structures, also the skin and fasciæ or other fibrous tissues beneath it to contract so as to produce fearful distortion; but I am unaware that there is any record of spontaneous contraction of these parts in a limb while it is in use. Ligament and fasciæ are planned, not as movers of a limb, but as checks to certain inordinate actions which might dislocate or injure the joints; indeed, they are not even intended to act as guardians of position. The structures, which maintain a limb in any posture, can only be those which place it in, or displace it

from that attitude, hence there is no instance in nature of any position being upheld by ligament or fascia. The ease with which ligaments are stretched in dislocations, show them to be incapable of resisting any great strain; the fact that the weight of a paralysed limb, if allowed to fall on the tissues of its upper joint (hip or shoulder), soon elongates the ligaments even to dislocation of the bone, shows that they cannot resist even a slight force for any length of time. Thus it is impossible that ligament can by its shortness produce or keep up, if unassisted, any considerable distortion.

We come, then, again to muscular tissue as the active agent in the production of malpostures, and, therefore, as they are produced by muscular agency, they can only be exaggerations of those positions into which the muscles can move the limb. The movements of the foot, however, are very complicated, hence the very position of a malposture is complex, as will be explained in the sequel; but at present, and for the mere purposes of terminology, we may divide club-foot into four principal cate-

gories, viz., distortion, by excessive extension, flexion, abduction and adduction; or, pes equinus, calcaneus, valgus and varus.

Now, it is evident, that if a limb be distorted by muscular causes, there must be want of balance among those organs. The inequality may logically be due to redundancy of action on one side, or to deficiency on the other; but although it is the orthopædic and tendon-cutting theory of club-foot that the distortion is produced by "convulsive" or "spastic" contraction of certain muscles, we shall, without any great strain upon our reasoning powers, be able to see that the existence of such causation is an assumption and a myth.

The universal law of all active muscular contraction, properly so called, is alternation with rest; no man, however powerful or determined, can maintain a posture, necessitating strong muscular action, for more than a few minutes. Convulsions, such as are common in infancy, produce movements, which are essentially alternations of contractile force between different sets of muscles. The fits of spasm in tetanus come and go; the longest

duration of such attacks occur under the influence of strychnine or brucia; yet even in that condition, when the spasms attain a certain persistency to be counted by minutes, death is close at hand. Moreover, such attacks, although they may produce a temporary malposture, never give rise to a permanent distortion, because, when the fit ceases, the muscles opposing the affected ones replace the limb.

Therefore, a convulsive or spastic contraction of muscles, although it may in rare and exceptional instances be powerful enough to cause a temporary distortion, cannot be persistent enough to produce any permanent deformity, while the opposers remain healthy.

It is singular that in all works emanating from orthopædists, and advocating that strange theory, we find certain instructions for the operation of tendon-cutting, viz., that the limb should be forcibly drawn by the operator or the assistant in such a direction as shall render the tendon to be divided sufficiently tight for the purpose. If, however, a muscle were so violently contracted (convulsively or

spastically) as to overmaster the force of the opposers, and in their despite to distort a limb, the tendon of that muscle must be more than sufficiently tight for division; indeed, its severed ends would fly asunder like a taut cable parting in a gale, and there would never be any chance of their coming together again any more.

Thus spastic or convulsive contraction, as a cause of distortion, is not merely pathologically impossible, but its non-existence is even experimentally proved. We must then seek elsewhere the cause of this want of balance, and since we see that when one set of muscles is convulsed, the opposers, remaining sound, prevent any permanent distortion, we are driven to the conclusion, that loss of power in one muscle or set of muscles may permit another group of organs to deform the limb.

Paralysis of a larger or smaller group of muscles is with children a frequent occurrence, and although it does not fall within the scope of the present work to discuss the large range of infantile neuro-muscular disease, I may be

permitted to point out its two aspects. How, for instance, *laryngismus stridulus*, or false croup, attributed by some to spasm of certain laryngeal muscles, is by others, and more reasonably, ascribed to paralysis of a different pair. Let it be observed, too, that the squint which may come and go with other symptoms of brain mischief, or may be a permanent affection, is certainly to be more rationally regarded as want of action in the outer rectus, which appropriates the whole of one nerve, (6th) than as spasm of the inner rectus, whose nerve (3rd) supplies four other muscles of the eye and appendages. There is therefore, on the spasmodic theory, no anatomical reason why internal squint should be so frequent, almost to the exclusion of deviation in any other direction; but on the theory of paralysis the anatomical cause is self-evident.

When paralysis of a leg occurs, the cases frequently enact before us the whole history of the formation of a club-foot. A child may be put to bed quite well, but the next morning is found to have lost the use of a limb; after a time the power very much returns,

except in certain directions; or the overture may run thus: the child is observed to become more and more awkward or unwilling in making certain movements, until the ability of using the limb, especially in certain directions, has ceased. From this point the two stories merge, the foot in either case tends to twist away from the direction, in which debility is chiefly manifested. The amount of deviation, ultimately attained, depends upon the age of the child and rapidity of his growth, upon the lapse of time before power returns to the weakened muscles, and upon the amount of power which they ultimately regain. The mode of production is thus easily followed; muscles while healthy are always kept at a certain degree of tension by tonic contraction, and the balance of that force in the different organs maintains the limb while at rest in a normal position and the joints firm; but if one side be paralysed this force ceases on that side, and the opposers slowly drag the limb from the side diseased; for a certain period after the commencement of deformation there is nothing whatever wrong with the muscles

towards which the limb is dragged, but after they have been allowed thus to retract for a certain time they become organically shorter (contractured). Still remaining active they then exert their power from a new and more advantageous base, thus gradually dragging the foot into an abnormal position, and producing permanent deformity.

The pathology is in these cases precisely similar to that lateral dragging of the features, depending upon paralysis of the side, from which they are drawn; a fact so well known that he who would treat, by cutting or otherwise, the side towards which they incline, would very justly be considered as ignorant of the more advanced surgical theories and practice of his time.

It should here be remarked that writers on this subject have divided paralytic cases of club-foot from non-paralytic. The difference really only lies in the period of disease at which the case is seen. Paralysis of young people is, under proper treatment, as a rule recoverable, but the weakened muscles will not, on their restoration, be able of their own

might to overcome and lengthen the deforming organs so as to replace the foot. If the case come under notice while power is still absent, it is, of course, called a paralytic case; but if it be seen after recovery from the paralysis, it is called non-paralytic.

We have now concluded our history of the cause and origin of non-congenital club-foot; but in turning to the congenital cases I am about to mention a fact which greatly assists and supports the system of pathology above laid down. Monstrosities are occasionally born into the world with some part of, or even the whole brain, absent: this condition is constantly accompanied by club-foot and club-hand, one or both. Now, absence of a motor portion of the nervous system is necessarily followed by want of power in certain muscles, but no connection is traceable between such deficiency and spasm.

We must now consider this coincidence of club-foot and deficient nervous system in connection with another fact, viz., that the muscles of animal life are developed in the fœtus—in dependence on—indeed as direct de-

pendents or appendages of the motor nerves.* Now, although, in the course of intra-uterine life, the different parts of the fœtal system are formed in regular succession, yet disorder sometimes occurs; one portion being not evolved at all, or its development being abnormally retarded. Such irregularity of development affects chiefly the nervous system; and when any motor portion is not produced at all, then the muscles corresponding thereto are not generated, and the severest distortions occur, as in the brainless fœtus. When the formation of any motor portion is delayed, then the dependent muscles are also produced too late; the properly formed ones therefore drag the limb aside, and a club-foot would be produced of an intensity, commensurate with the amount of retardation in the development of the nervo-muscular organs.

No mention has hitherto been made of the prevalent notions concerning the production

* *See* E. H. Weber. "Ueber die Abhängigkeit," &c.; "On the Dependence of the Development of the Animal Muscles on the Animal Nerves."

of congenital club-foot by some mental impression of the mother; because the stories and imaginings of this sort are too vague to be treated scientifically; and as they are necessarily *post facto*, are always untrustworthy. There remain, however, the theories concerning position of the child in the womb to be briefly examined. The idea of causation by pressure of the foot against the uterine walls is untenable: because the distortion is found at so early a period (third or fourth month), that no such pressure could have existed; that they are found when the fœtus has been abundantly protected by surrounding fluid (*Liquor amnii*), and because a constant pressure of any part against the walls of the womb is incompatible with continued gestation. The idea promulgated by Cruveilhier, that the foot was pressed against the child's chin, is ingenious; but the fact that such distortion is most prevalent in the acephalous fœtus, which has no chin, bears strong witness against it; particularly as in so many congenital cases movement has been strongly felt, and therefore the posture and the direction of

pressure must have constantly varied. Besides these difficulties, it is on consideration utterly impossible to believe that a cause so varying in amount, place, and direction as external pressure, could produce such constantly recurring types and such similar distortions. In fact, it is necessary to give up altogether the frequently repeated hypothesis of the mechanical production of club-foot.

The only tenable theory, the only doctrine in any degree consistent with facts, teaches that club-foot, both acquired and congenital, is produced by deficient action on the side of the limb from which the foot is drawn. Moreover, it is easily comprehensible, that the originally feeble muscles, having been weakened by disease, and stretched by the healthy ones, can neither regain their normal length nor power sufficient to overcome their opposers and replace the foot.

Orthopædism has endeavoured to restore the lost balance by annihilating the still healthy muscles, and reducing the whole limb to a state as debile as the parts originally diseased. I prefer to restore equilibrium by

again rendering the weakened muscles strong and active. Before however explaining my own means of cure, it is necessary to examine into the effects of cutting tendons and of fastening the feet in iron.

CHAPTER III.

ON THE IMPROPRIETY OF TENDON-CUTTING, AND ITS EVIL RESULTS.

THE operation of cutting tendons or muscles had been haunting the domains of legitimate surgery for about one hundred and fifty years, and had been gradually becoming a less adventurous proceeding, when, in 1832, Stromeyer demonstrated a method of its performance without danger, or at least with very little danger, of producing suppuration and sloughing. No sooner, however, was this point established, than the operation was driven to the most unbounded exaggerations, under which it is still labouring. The immediate results were apparently so brilliant, that at first the profession, then the public, were captivated by the procedure; no time has as

yet been given to observe whether the prospects, which these first effects open to us are fulfilled, nor whether other evils quite as bad or worse than the original deformity are produced by the operation.

A goodly number of club-footed patients come under notice with the paralysis still continuing; a good many with the muscles still excessively languid. The patient is in one of the following conditions: he either has too few muscles, or some of his muscles are too weak to act: and the so-called orthopædic practice of the present day is, unfortunately, to cut the tendons, and destroy the power of those organs which are still healthy. It is quite certain, that if all the active tendons and some of the passive ones be divided, so that there be nothing to resist any external force, the foot can be squeezed into something like shape; but to the annihilation of its power. That the above is not a misrepresentation of tenotomist treatment may be seen by the following: "Upon attempting to adduct the feet, the peronei and common extensor were rendered extremely tense; upon attempting to

flex the foot, the tendo Achilles was also tense; and upon attempting to depress them (*sic*), the anterior tibial and extensor proprius pollicis were also tense, there being the smallest possible amount of motion in the ankle-joint, and that of an unyielding character. I therefore proposed the division of the whole of these muscles."* Again, another writer says: "The peronei tendons are to be divided, or, together with them, those of the extensor longus digitorum and the tendo Achilles; and also those of the tibialis anticus and extensor proprius pollicis; after which," the author adds, "there is considerable difficulty in continuing sufficient support to the arch of the foot, and even after the arch has been restored support has to be continued for many months."† Truly it would be very wonderful if such were not the case. We find also that varus is treated upon a similar plan, namely, that of dividing every tendon whose muscle still appears active enough to resist any force applied from without. For instance, the tendons cut

* Tamplin on "Deformities," p. 77.

† Broadhurst on "Club-Foot," pp. 122 and 124.

are the tendo Achilles, tibialis posticus, flexor longus digitorum, and tibialis anticus; sometimes also the extensor longus digitorum and the plantar fascia. We might consider such divisions, even under ordinary circumstances, sufficiently severe; but let us for a moment imagine it when most of the uncut muscles are paralysed, and we shall have to picture to ourselves the foot as an inert mass, hanging to the end of the leg like the swinger of a flail. This disabled member is then subjected to shoes, and screws, and straps, until it is forced into a shape which looks very fairly in a cast or a woodcut, of the "before and after" type of illustration; but in real life, and in the act of walking, the limb is a far less desirable member than it appears in effigy.

If, however, the parts would, as a rule, recover themselves, and if the results of such extensive division of tendons would pass away, very little blame could be thrown on the operation; but the truth is, that we again and again see cases, in which the only muscles having no power, that is, the only irrecoverably lame ones, are those that have been cut;

or, what is not quite so bad, neither the tenotomized muscles, nor the ones that had been paralysed, have any power over the limb (except perhaps the sural muscles), and it swings almost uncontrollably with the walk, being sometimes put down on one side, sometimes on the other, the toes being generally the only part that comes to the ground.

It has fallen to my lot, during a life of close observation, to see many cases of this sort; indeed, at the present time, I have two patients under my care, one of whom has been the subject of tendon-cutting treatment ever since his birth, ten years ago; the other not quite so long. Both have worn all sorts of irons and shoes for years, with the result of still further weakening the limb. They have neither of them the power of controlling the way in which the foot shall come to the ground, and the Achilles tendons are contracting in both, so that the deformity is being reproduced.

There is now (July, 1865), at the Charing Cross Hospital, a girl, aged 13, who is under care for an inflamed bursa of the right knee.

Her left foot being much deformed attracted my attention; her history is as follows: From the age of three months till the age of twelve years and two months she was a constantly-attending patient at the Orthopædic Hospital; during the whole of that time she wore shoes and irons of different forms, and in the course of that period she had tendon-cutting operations performed on her foot nine separate times. The result of this long treatment is as follows: the leg is shrivelled, the fore part of the foot is loose and powerless—she cannot get the heel to the ground.

It is now high time that the advantages and disadvantages of tenotomy should be fairly scrutinized. We will begin with the tendo Achilles. The excellent Prussian surgeon above named, who realized the safe method of dividing tendons under the skin, had made his first attempts on this part; and, as it happens, this is, of all tendons probably in the whole body, and certainly in the foot, that which lies most convenient to the knife of the surgeon, and most advantageously situated for reunion: it is isolated, lies close to the skin, and is sur-

rounded by a quantity of loose cellular tissue and fat. Thus, to produce a non-union of this tendon would require a diligent application of ignorant interference; and if it unite, as I believe it always does, to some of the neighbouring cellular tissue, that material is lax enough to render the adhesion of slight or of no consequence.

Nevertheless, we are not to imagine that the operation is necessarily productive of good results, or that it may not be followed by certain ill effects. It must be remembered that the muscular contraction has only taken place in consequence of deficient resistance. By dividing the tendon we completely cut off all connection between the muscle and the foot, annihilating all resistance to contraction, and as a consequence the calf retracts in the leg, shortening itself to the extent of an inch or more. In the course of two or three days a new material, of commensurate length, re-unites the two ends of the tendon, the connection between foot and muscle being thus re-established. But the latter, having retracted at the operation, is of course shorter than ever, and to its

force is now added the constringent power of the new material between the ends of the tendon. The situation of this fresh matter enables to it exert its contractile force both on the muscle above and on the foot below; naturally, therefore, the weaker part must yield. Since, however, the muscle is of itself strong enough to distort the foot, the added power of the scar must increase the distortion unless counteracted. But the foot is prevented from yielding by machinery; it is even screwed towards a natural position, and the scar material may be stretched to a certain amount while it remains soft. But it very soon becomes too hard to be stretched, and even in hardening contracts again to at least the same amount as it had previously yielded, the scar, after a period, being of the same length, or indeed a little shorter, than the interval between the tendinous ends, produced at the moment of division by contraction of the muscle. Or to put it in other words, the gap formed at the instant of operation is produced by contraction of the calf muscle, and not by improved posture of the foot, since no change of posture takes place at

the time. As soon as the new material filling this gap becomes too hard to be stretched by practicable instruments, it contracts again, and the force of this contraction, as well as the power of the machine on the foot, is exerted on the muscle. Therefore, as this scar decreases rather than increases in size, it follows that the muscle, not the tendon, is the part stretched; and this result might just as well have been effected without any use of the knife.

Hence the tenotomy has simply had the following results: it has allowed the calf to shorten, and therefore produced of itself a certain deformation and debility; it has not superseded by a single day the use of mechanical force, since, after all, the muscle is the part that must yield. The operation renders the first application of machine power apparently more effective, since there is nothing to resist its action; but the work to be done is only postponed till solid union has taken place, and thus the division of the tendon has simply wasted all that time, which was employed in the repairs of the artificial injury.

There are a few very rare cases, and these chiefly from want of development, in which we may be compelled to accept these ill consequences of dividing the tendo Achilles for the sake of some immediate advantage,* for the sural muscles are peculiarly placed, and if they be insufficiently developed, their shortened condition may be difficult to overcome. We have seen that this tendon is remarkably well situated for operation and repair; let us examine some others which are generally the subjects of division.

The tendons, which pass in front of the ankle-joint, are bound down tightly by a strong band of fibrous structure, which runs across them, and partially invests them; moreover, each is provided with a synovial sheath. Those, which lie behind the joint, run in grooves of the bone, wherein they are encased by very strong fibrous or ligamentous bands. There are two behind the inner ankle and two behind the outer ankle, running close

* It will be seen when we speak of talipes equinus that these advantages are very much less than is believed, and are generally imaginary.

together, and one, the flexor longus pollicis, between the pairs. Their situation, and the way that they must pass under the ankle to get to the foot, causes them to press very tightly against the bone; and, to prevent their slipping out of the groove, the fibrous sheaths are strained firmly over them; lastly, they are provided with synovial membranes; in fact, the tendons lie in very tightly-fitting tubes. When demonstrating anatomy at St. Thomas's Hospital twelve years ago, I frequently showed this disposition to the pupils, and would point out, that when such a living tube was wounded, and a tendon fitting it tightly was cut, how extremely unlikely it would be for the tendon to reunite without also uniting to the tube, either at the wound or elsewhere, and that if both tendons were cut they would adhere together.

I would here refer to four experiments on dogs performed and reported by M. Bouvier,* in 1842. He divided subcutaneously the *flexor carpi ulnaris* and *radialis*, the *flexor digitorum sublimis* and *profundus*; in one case

* "Bulletin de l'Académie Royale," t. viii., pp. 115—117.

all of them, generally two or three only; in no one instance did the subcutaneous wound unite so as to restore the use of the parts. In one experiment the two divided tendons did not unite at all; in another, all the severed structures were massed together, thus destroying their normal functions; and in two, besides this latter condition, the new tissues bound the tendons firmly to the bone, so as utterly to annihilate all muscular action. This last event was found also in a horse, operated on by M. Bouley. Thus we have five experiments on animals in whom some tendon other than the Achilles was divided, with the result in every case of destroying the action of the muscle.

It may, however, be easily affirmed that such experiments cannot be accepted as proof of what occurs in man; we will go a step further.

There has been for some time, raging among tenotomists, a difference of opinion concerning the mode in which tendons were supposed to unite, and quantities of rabbits have fallen victims to the dispute; but the tendon chosen for the experiments was always the tendo

Achilles. Anxious, however, to prove what appears to him the right view of the case, Mr. Adams has made it a point, whenever any tenotomized patient had died from other and fortuitous circumstances, to obtain leave for an examination of the parts. It is to be supposed that he found the facts, so obtained, support his idea of an intermediate uniting substance, since, about four years ago, he published the series, together with his experiments.* I also found that these results fully supported my opinion, namely, that such tendons as those whose position I have above described, form union rather with the surrounding tissues than between their divided ends; which opinion has been greatly strengthened by the specimens, brought from time to time before the Pathological Society. Now, the cases of post-mortem examination in the book referred to, amount to twelve; in five of them the tendo Achilles only was divided, with which tendon we are not now dealing; there are therefore seven in which other tendons were divided, and I have made

* "On the Reparative Process in Human Tendons."

the following analysis of the results as to union, non-union, &c.*

No. of Case.	Tendons Divided.	Results observed.	Time lived after Operation.
I.	Tendo Achilles; Tibialis anticus	Non-union of tibialis anticus	4 days.
II.	Tendo Achilles; Tibialis anticus; Tibialis posticus; Flexor longus digitorum	Non-union of tibialis posticus; Non-union of flexor longus digitorum	11 days.
III.	Left: Tendo Achilles; Tibialis posticus	Tibialis posticus, adherent to the bone	23 days.
	Right: Tendo Achilles; Tibialis anticus; Tibialis posticus	Tibialis posticus was supposed to be, but was not, divided	30 days.
IV.	Tibialis posticus; Flexor longus digitorum	Union to all surrounding parts; No union: held together by shreds of sheath, to which other tendons also adhered	18 days.
V.	Tendo Achilles; Tibialis anticus; Tibialis posticus; Flexor longus digitorum	Tibialis posticus and flexor longus digitorum adhered together and to the bone	6 weeks.
VI.	Tendo Achilles; Tibialis anticus; Tibialis posticus; Flexor longus digitorum	Tibialis posticus and flexor longus digitorum adhered together and to the bone. Ends of tibialis anticus hung together by shreds of sheath	6 weeks.
VII.	Tendo Achilles; Tibialis posticus; Flexor longus digitorum	Non-union of tibialis posticus; Neither retraction nor extension of the flexor longus digitorum	Several years.
VIII.	Tibialis posticus	Union to bone	17 days.
IX.	Tibialis posticus	Union to bone	

* Since the first edition of this book was published, another case has been brought before the Pathological Society, by the same gentleman, in which operation was performed on both feet. They are included in the Table and analysis.—*Path. Trans.*, vol. xv.

The result, therefore, of the cases is this, that out of six divisions of the anterior tibial tendon, we have two non-unions,* *i.e.*, in a third of the cases operated on, the muscle is destroyed. In every one of the nine instances in which the posterior tibial tendon and each time the long flexor of the toes were divided, one or both, the action of the muscles was utterly annihilated, and of course lameness and want of power in the foot must be the result. It happens that we have no case in which the peronei were divided, but as their position behind the fibula is precisely analogous to that of the others behind the tibia, there is no reason to doubt but that their division would have identical consequences.

Now, these are the only cases of post-mortem examination after tenotomy (it has taken nearly twelve years to get them together); their results are not only compatible with experiment, but perfectly such as we should reasonably expect from a consideration of the

* From some of the descriptions it appears to me that adhesions were present in other of the cases, but as this is not clear I have not noted them.

structure of the parts; and we can draw no other conclusion from them, but that such tendons as lie in sheaths close to bones, namely, the posterior tibial, the flexor of the toes, and the two peronei, might as well be struck by sudden and irremediable paralysis, as be subjected to the knife of the tenotomist; and that other tendons, those in front of the foot, are only a little better off in this particular.

There is no doubt but that tenotomists have felt this danger, and they have talked about avoiding it by dividing the tendons so high up the leg as not to implicate the sheaths. This, however, is an impossibility. That structure does not begin with a sharp, sudden edge, but is a part of a strong deep fascia of the leg; which binds down the muscles themselves, and which gradually gets thicker as it descends. Thus it is not the mere bare tendons alone which are ensheathed; the posterior tibial muscle, for instance, although it forms its tendon pretty high up in the leg, continues to arise fleshy from the bone till very near the malleolus. The long flexor of the toes ceases to be muscular a little higher,

but below the point where it becomes encased in a sheath of fascia. Therefore there is no place for dividing these tendons so that they can reunite and retain their action; and thus although, as I have already remarked, the foot after such an operation may be squeezed into some approach to form, the limb is lame; it is indeed more hopelessly lamed than before the treatment.

But I must make a still further observation on one of these cases, namely, Case iii. in the list. In the right foot of that unfortunate patient, an attempt had been made to divide the posterior tibial tendon, and the limb had yielded to the shoe so easily that the tenotomist imagined he had been successful. On examination, however, after death, it was found that the tendon had not been divided. Now this event discloses a most extraordinary fact, namely, that these tendons are often so little resistant, that the orthopædists do not know by the after symptoms, whether they have been cut or not. At all events in a certain large proportion of the cases, the feet would be quite as amenable to force without the

infliction of such treatment, and that even with the aid of the mechanisms at present in use.

Thus, just as in the last chapter (p. 20), we found that the practice of tendon-cutting experimentally disproved the theory (spastic contraction) on which it is founded; so in the present chapter do we find that this practice proves both its utter uselessness and disastrous effects.

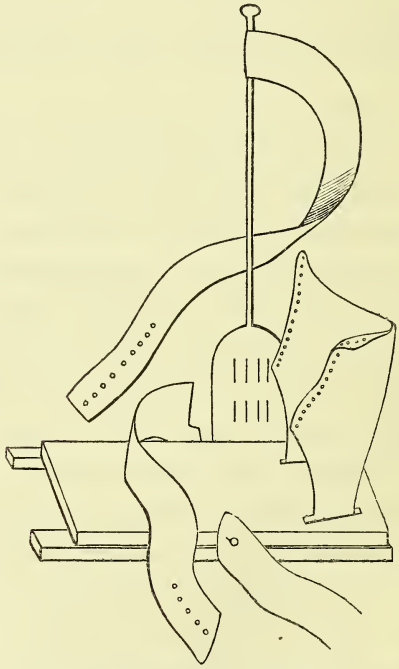
CHAPTER IV.

THE MECHANICAL AND AFTER TREATMENT.

After division of the tendons, the foot, according to the orthopædic fashion, is fastened into a metal clog provided with screws, and a spring intended to press the limb into shape. At the present day these instruments are all founded on the same principle, taken from Scarpa's plan, although almost every orthopædist has a shoe of his own, in which he sees certain excellences, absent in his neighbour's. Before Stromeyer ultimately established the immediate safety of subcutaneous tenotomy, shoes of some sort or another were used for the reduction of club-feet, and with sufficient success to give to certain cleverer machinists or better manipulators than their

fellows a wide celebrity. At the latter end of the last century, four specialists had such reputation, Jackson in England, Tiphaisne and Verdier in France, and Venel in Switzerland. They all kept their particular mechanism secret; but by means of a patient treated in the Swiss Institution, so much oozed out of

FIG. II.



From Mellet's "Manuel d'Orthopédie."

Venel's machine as to induce three Germans (Ehrenmann, Brückner, and Naumburg,) to make others in imitation. The instrument consisted of a wooden shoe or sole, at right angles to which was affixed a staff of the same metal. When the foot was firmly fastened to the former, the staff was gradually approached to the leg, so as to make the sole face more and more downwards. I think there can be no doubt but that Scarpa took the plan and idea of his instrument from Naumburg's * and Brückner's † imitation of Venel's apparatus, and substituted a perpendicular spring for their upright staff, and a horizontal one for their mechanism to overcome adduction; an idea which, if we credit his friend Malfatti, he had obtained from Tiphaisne in a manner which in England is considered discreditable, namely, by bribing his housekeeper.‡ However this may be, Scarpa's shoe has become the mould, in which all other orthopædic instruments have been cast. It consists of

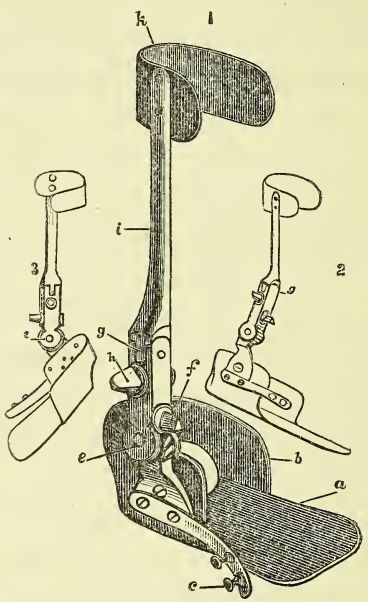
* Abhandlungen über Verkrümmungen, 1796.

† Ueber Einwärts gedrehte Füsse, 1798.

‡ See preface to Malfatti's German translation of Scarpa's work, "Sulle Piedi Torti," p. iii.

a shoe carrying a horizontal spring for exerting sideways pressure; a perpendicular spring attached to its edge, and strapped below the knee with more or less tightness, intended

FIG. III.



THE IRON FOUNDATION OF AN ORTHOPÆDIC SHOE.

1. The shoe in a straight position. *a*, The sole; *b*, the semicircular portion to embrace the heel, a portion being cut away, leaving a hole for the point to protrude; *c*, the horizontal spring for abduction of the foot; *e*, a hinge in the upright portion; *f*, a triangular screw-head, which being turned with a key, causes the toe of the instrument to point downwards, as seen at 3; *g*, another hinge; *h*, a triangular screw-head, which, being turned with a key, bends the foot part outwards, as at 2; *i*, the upright staff; *k*, the semicircular part to go round the leg, and act as the fixed point of the apparatus.

to twist the shoe and the foot on its long axis, and make the sole face downwards. A little alteration in this apparatus is made by substituting for spring power a screw force, which necessitates the more frequent attendance of the orthopædist with his key. The plate gives a sufficient idea of the steel groundwork of the machine before padding and straps are added. There is an iron sole the length of the foot, the heel being enclosed in a semicircular portion, which comes forward as far as the ankle bones, and serves for the attachment of the other parts. These are a horizontal spring to abduct the foot, and a perpendicular lever which is fastened above the middle of the leg by a semicircle of steel behind, and a padded strap in front. A little above the place where this lever is fastened to the foot portion of the implement, may be seen two screws with triangular heads; the upper one screws the shoe, and with it of course the whole foot outwards or inwards; the lower one turns them up or down in the direction of flexion or extension. Now, it needs only one glance at this instrument to

see that the whole of its rotating and flexing power are exercised on the ankle-joint; the same thing applies to those in which a spring is substituted for the perpendicular staff.* However such implements may be varied, whether by retaining the original rod of Venel, or substituting the perpendicular spring of Scarpa, or making a joint-work by a cog-wheel instead of a screw, &c. &c., they all are formed essentially of an unyielding sole, to which the child's foot is fastened, and then twisted round *as a whole,* as nearly as possible on the ankle-joint, which really has no rotatory movement, and therefore nothing to do with the malpostures of rotation. It is not of any importance, as long as that principle be retained, whether screws or springs be used; whether the spring be of steel, or of any other possible material.

After the tendons have been divided, the child's foot is fastened to an instrument of the above construction, and the screws are turned,

* A dreadful defect in the instrument depicted is that the rotating and the flexing forces are exerted in different parts of the perpendicular rod, and that one must necessarily, and both may be false to the place where the human ankle bends.

or the spring tightened by degrees, twisting the ankle-joint more and more until the sole, or at least part of it, looks directly downwards. Let the reader consider our description of the medio-tarsal joint, of the manner in which the front of children's feet can be turned round upon that articulation, till the fore part of the sole looks inwards, and can be adducted and flexed to a marvellous degree. Let him also remember that every muscle except the tendo Achilles and a portion of another is inserted in front of that joint, which must therefore yield to all muscular action, and that to such action club-foot is due. Let him also examine a club-foot—a varus for instance—and he will very soon be convinced that the real deformity lies in the front of the foot; also that the change in position at the ankle-joint is secondary and really very slight. In fact, he will see that the front half of the foot is *rotated and adducted upon* the back portion; and that therefore to overcome such deformity the force must be applied to the anterior part of the limb. Therefore, that any shoes, whether of Venel, Brückner, Scarpa, or others, having

rigid soles, acting upon the foot *as a whole*, and not taking into consideration the twist in each portion of the limb, nor the position of muscles attached to each bone, are very ill-adapted for the cure of club-foot, whose very essence lies in those hitherto unnoticed particulars.

But as the tendo Achilles is attached behind the medio-tarsal joint, indeed behind the ankle-joint altogether, as therefore the foot might be supposed to act in extension and flexion as one mass, it might be considered advisable to treat by shoes, and *as a whole*, such deformities as equinus and calcaneus. We shall see at its time and place what is the real condition of equinus: but in the meanwhile, let any one who can imagine the foot a solid mass, carefully watch a barefooted man, woman, or child, walking even slowly, let him try to imagine those elastic movements, which he will then perceive increased into running, dancing, or leaping; then let him, if he can, imagine the desirability of treating the foot, *as a whole*, in an iron-soled shoe. Another, even a more urgent reason why the treatment by such instruments is so unsatisfac-

tory is this: the greater number of, if not all, deformities are, as we have seen, produced by debility or paralysis of the muscles. Now, as soon as a muscle is thus circumstanced, everything which might aid fatty degeneration, ought to be avoided; for in youth by far the larger number of paralyses are curable, while such degeneration can be prevented.

There is yet a fourth cause for dissatisfaction with these instruments, a cause still connected with the repose which they enforce; a muscle elongated by some external power while it is at rest only preserves this elongation as long as rest continues. Thus when the machinery is removed, the limb may perhaps retain its new position until it be used; but the muscle, long left in repose, will when it resumes its contractile action, carry that function back to the same point as before it was abrogated by the restraining force; hence with the power of movement the deformity returns.

The nugatory effect of this treatment on the sound muscles is however of little moment in comparison to its influence on those which were paralysed or weakened. Tissue de-

generation of every organ follows loss of function, whether such loss be due to internal or to external causes. The function of muscle is motion, therefore the great remedy for paralysis, the true preventive of this corruption of muscle, is movement of some sort or other. But orthopædic treatment is peculiarly adapted to delay the recovery and hasten degeneration of tissue. The non-paralysed muscles are cut, ensuring to them the most complete loss of function, while the foot is fastened to iron plates in such wise as to prevent as far as possible any movement of the sole and all muscular action, and this confinement is enforced for six weeks, for six months, even for double as many years. Of course when this treatment is discontinued, all the muscles will have been reduced to the last stage of debility, and the patient will be fortunate if fatty degeneration have not advanced far enough to deprive him of the use even of those muscles which have not been cut, and still more fortunate if, at the end of the process, he be not obliged to wear for the rest of his life a heavy iron.

The treatment thus described, what with repeated operations on the tendons, the long use of shoes, and necessary alterations from the production of ulcers by pressure, &c. &c., is long, wearisome, frequently very painful, but inspires much faith. If, therefore, time and opportunity ought to be productive of successful practice, we might expect, in these instances, the most splendid effects. The fact, however, that the results are not brilliant, are indeed anything but satisfactory, is an additional proof of the false method of treatment. The feet of the patients are not by any means restored to their natural shape, either retaining a good deal of the original deformity, or acquiring an opposite distortion, one altogether of an artificial character; moreover, they are very powerless, come heavily to the ground *en masse;* they are not raised in walking, deftly and naturally, but as a lump hanging at the end of the leg. It has been my fate to see a great number of people after orthopædic treatment, and I have not met with a single instance of efficient cure, except one or two mild cases of equinus, and even

these bore evidence of artificial injury. It has been remarked of the first edition of this work that my statements concerning the condition, left after treatment by tendon-cutting and shoes, were highly coloured; to exonerate myself from such charge it has become necessary to adduce instances. The following cases are therefore inserted here:

Case I.

H. C., aged 10, was born with an equinus and a certain amount of varous inclination of the foot. Ever since birth until he was nine years old, he has been under the care of various orthopædists. During that period the anterior and posterior tibial tendons, and the flexor longus digitorum have been cut; the tendo Achilles has been twice divided. He has been kept in bed at different periods for three or four months at a time; he has worn shoes which have produced considerable suffering, also heavy irons rendering walking very inconvenient and painful.

At the age of ten the foot is still equino-varous; the boy has very little power over it; it swings at the end of the leg, but always with most inclination inwards; the heel never comes to the ground; and although the anterior ends of the metatarsal bones are much spread, yet the outer one bears the chief weight. The leg is very withered and thin, the thigh powerless.

In fact, after nine years of orthopædism the foot is still club, not quite so much so, perhaps, as if it had

not been treated at all; it may have gained something in form; but it has certainly lost a good deal in power.

Case II.

Emily Adams, aged 13, became an in-patient under Mr. Canton, at the Charing-cross Hospital, for an inflamed bursa over the right patella, June, 1865. Taking the service of Mr. Canton in the early part of July, I observed that the left leg was much shrivelled, and examining it, perceived that the foot was deformed. The following is the history given:

She was born with a deformity of the foot; from the age of three months till about a year ago she was constantly under treatment at the Orthopædic Hospital, between that age and ten years her foot was operated on nine separate times. During the whole of that period she has worn different shoes and irons; the last, an ordinary boot with an iron hinged in the sole, and running up the leg, was discontinued less than a year ago; that is, after she was twelve years old.

The accompanying photographs represent the present condition of the limb. The foot is an inch shorter than the other; the heel is small, non-developed, but in proper relative position to the ankle-joint, its skin quite soft and unused.* The front half of the foot is much depressed (the medio-tarsal joint flexed), so that the arch is greatly increased, and the ball of the toes is projected downwards. There is the usual claw-like bend of the toes, and the splay position of the meta-

* We shall see in the sequel that the primary defect in equinus is not raising of the heel, but dragging downward of the anterior tarsus. We shall also perceive that when in childhood the heel does not come to the ground its development is impaired, producing an appearance often mistaken for lifting of that bone.

tarsus. She has no power over the front of the foot, so that, when the limb is lifted, that part falls into a more incurvated posture; the weight pressing upon it (as depicted in the photograph) somewhat straightens out this arch. The leg, even the thigh, of that side is much shrivelled. The girl's walk is very lame; the toes only come to the ground; to bring the lame foot forward, the whole body is swung upon the hips, and again a jerk is given to throw the weight of the body upon that foot, and at the same time to bring the other forward as rapidly as possible to relieve the weak limb. (Plate i.)

In this case, then, we have before us the result of more than eleven years of orthopædic treatment, and nine operations. I must now refer to two other cases, viz., those of B. M. and of S. J. A., at the end of chapter ix.

PLATE I.

Artificial Deformity.

PLATE II.

Flat Foot.

To face page 60.

CHAPTER V.

MY NEW METHOD OF TREATMENT.

I HAVE devised and carried on to success a plan of treatment diametrically opposed to that by tenotomy, and utterly different to that by shoes. It is conceived and founded on the following principles:

1st. That as the loss of balance in muscular action, which produces the deformity, is caused by paralysis or debility of a certain set of muscles, we are to restore that balance.

2nd. This restoration is to be accomplished by substituting a force for the weakened or paralysed muscles, and not by depriving the still useful ones of their power.

3rd. That the succedaneum must be applied as nearly as possible in the direction and posi-

tion of the paralysed organ or organs, and must act on the parts, and on those only, on which the muscular force is normally expended.

4th. Thus the foot is not to be treated as a whole, but as a compound of many bones, each of which being subject to muscular action plays a definite part in deformities.

5th. That since motion is essential to prevent or overcome fatty degeneration, as well as to allow the weakened muscles to recover their power, the foot is not to be fastened to any rigid clog, but, on the contrary, each part is to be allowed movement, which is gradually to be guided by the imitative force from an abnormal into the normal direction.

6th. That since a muscle stretched while at rest only remains elongated during repose, it is necessary to prevent return of distortion by accustoming the muscle to act while under the influence of the elongating force, and in the limits of its increased and normal length.

These principles, which are logical and physiological, had not been founded nor

applied to the establishment of a new plan of treatment previous to November, 1861, at which time my paper entitled "On certain Grave Evils resulting from Tenotomy, and on a New Method of curing Deformities of the Foot," was read before the Medico-Chirurgical Society, and has since been printed in the "Transactions."* The means which I adopted to carry out the problems set up, were to substitute for the absent or diminished forces a spring or springs of india-rubber, stretched between the origin and the insertion of the muscle, at a degree of tension that would supplement the weakened or supply the absent power of the organ. The insertion of the muscle was evidently to be imitated by adhesive plaster fixed over the place of attachment for the tendon. But there was great difficulty in imagining any mode of obtaining a fixed point upon the leg, as a substitute for the origin of the muscle or muscles without causing constriction of the limb, until the plan shortly to be described was adopted.

* Vol. xlv. p. 25, *et seq.*

It will be as well to give some notion of the amount of extensibility and of power which an india-rubber spring possesses. It can be stretched to six times its length without losing contractility; when extended further the material yields. It appears capable of bearing extension within these limits for any indefinite length of time, and yet at the end to be hardly weaker; it is also able to support alternate extension and relaxation, however rapidly and frequently repeated, with but a small loss of power. I believe myself right in the details of an experiment which was mentioned to me, but the narration is from memory. A gentleman had at his works an engine, which was kept going night and day; he carefully measured an india-rubber spring, and fastened it to some part of the machine, which extended it to four times its length nineteen times in the minute; at the end of nine years it was found longer by one-twelfth only of its original length.

The mathematical formula for determining what amount of force is being exerted by the spring is this: let l = unstretched length of

spring; l' = its stretched length; T = tension of spring; c = a constant, then

$$l' = l\left(\frac{1+T}{c}\right) \therefore T = c\frac{l'-l}{l}$$

If a be the length of the string when 1 lb. is hung on it, then

$$1 = c\left(\frac{a-l}{l}\right) \therefore T = \frac{l'-l}{a-l}$$

That is to say, extension in general, *i.e.*, the additional length to which the spring may be pulled in any one individual case, divided by the additional length produced when a one-pound weight is hung on it, will give the number of pounds pressure which the cord is exercising in the particular case. Suppose we find that one pound adds a quarter of an inch length to the cord, if at any time it be stretched an inch, a force of four pounds is being exerted; if it be stretched four inches, sixteen pounds, and so on. I have all my springs made of the same sized cord, and of certain definite lengths. Knowing the strength of the cord, I can immediately tell what force is exerted by any spring. We will not dwel

longer on the application of this method in general, but will pass on to describe the treatment of the different morbid conditions and deformities of which so frequent mention has been made; and although paralysis of the lower limbs does not strictly belong to the subject of club-foot, yet since partial or total loss of power has been shown to be closely connected with distortion, we shall first consider the treatment of that malady.

CHAPTER VI.

ON INFANTILE PARALYSIS—ITS AFTER EFFECTS AND TREATMENT.

The form of paralysis, with which we have here to do, is not that which results from progressive muscular ataxia, not that rare and forlorn condition which originates in some tissue change of the muscles; but it is that infantile paralysis which has been called spinal (Heine), or, by some authors, reflex.

However tempting be the pathological aspect of this subject, we must not be betrayed into filling otherwise appropriated space with its elucidation; yet it is desirable to consider shortly the different modes of its appearance and advent.

The attack sometimes takes its effect suddenly; a child being put to bed well and

taken up next morning, without the power of moving one or the other limb; sometimes such occurrence is preceded by slight feverish symptoms, by irritation, pain and heat in the mouth, also by heat and throbbing of the head. Again, the paralysis occurs after convulsions, after diarrhœa and sickness, or after one of the acute exanthemata. It does not appear to me that the presence or absence of any anterior sickness, nor that the more or less severe character of the antecedents has anything to do with the intensity of the paralysis. Some of the worst cases of this kind that I have seen, were neither preceded nor accompanied by any disturbance detectable by the parents.

The extent of the paralysis may be very variable, and its distribution is frequently capricious; thus a leg or both legs may be attacked, or certain muscles of one or both legs, or of an arm. The deltoid alone may lose its power utterly and entirely—so also the muscles of the rump may be affected alone or in combination with the adductors, while the parts lower down may remain healthy, or

being originally slightly affected, recover rapidly. The most common form of the malady is that it should attack but one leg from around the hip and downward, and so complete may be the paralysis that, if it be not ameliorated, the unsupported weight of the limb will gradually drag the thigh bone out of the socket; but if it be relieved, the amelioration will take place irregularly and slowly.

It is upon some of the phenomena of this phase between onset, persistence and recovery, that I wish especially to direct attention. Shortly after the attack, the limb will lose temperature rapidly, and be found colder than the opposite one; the tissues will all be soft and flabby; and these conditions lead us at once to the idea of impaired nutrition. But we must not be led away by appearances; it is not until the paralysis has lasted some time that the muscles themselves begin seriously to waste—in fact this form of paralysis is not accompanied or immediately followed by want of nutrition nor by degeneration, and until this latter phase has set in and proceeded to a cer-

tain extent, this kind of paralysis is under good management curable, if we carefully avoid confining the limbs in stiff inelastic instruments. Therefore our great object in treatment is to prevent the occurrence of degeneration, and the means that we must employ for this purpose will be the same that will be most useful for recalling power.*

It has already been shown (p. 55), that movement in some form is the principal preventive of this muscular atrophy, the difficulty often lies in causing the organs to contract. When a child is first paralysed, and for a certain number of hours after the attack, the muscles of the limb are quite immovable and perfectly flabby, that is to say they have lost not only the power of voluntary contraction

* Being desirous of economizing space and avoiding the medical aspect of this malady, I purposely omit mentioning, in the text, the signs of the times when leeches are beneficial or hurtful; also the value of belladonna, combined or not with hydrocyanic acid; the extraordinary power, at a certain point of the malady, of a very hot and rapid bath. The extreme sensitiveness of children to certain internal and all external agencies, puts into our hands vast power both for good and for evil; much discrimination and insight into their fugitive conditions will lead to our using these influences aright.

but also their tonicity. After a time, however, this latter property returns to some of the muscles very completely, to others in a far less degree. It is our duty to take advantage of this condition to force the muscles into contraction by means of combining with passive motion, certain manœuvres destined to make those organs follow the positions impressed upon the limb. These are chiefly rubbing—alternations of heat with cold and electricity. It is not however on their mere use that I wish to insist, but on the method of rendering the one set of measures subservient and auxiliary to the other. Thus when the thigh and leg from the hip downward has lost power, and when the proper medicinal treatment for the removal of the immediate or exciting cause has been duly employed, we are to endeavour to make the muscles act. I am adverse to the immediate employment of electricity or galvanism, especially if the attack have been ushered in by convulsions, having seen certain injurious results thereby produced; but recommend the following local treatment. The limb is to be held straight

and the amount of relaxation or flabbiness of the flexor muscles examined—then water, not quite hot enough to produce absolute pain, is to be applied with a cloth or sponge to the flexor muscles, and the knee at the same time is to be slowly bent and the muscles rubbed upward (towards their origin) with the sponge or cloth. Then the same manœuvre is to be repeated *mutato nomine* with the extensors, with the rotators, &c., &c., always slowly moving the limb in the direction of the muscles, whose coverings we excite by the caloric.

It will become the surgeon's duty to teach the mother or the nurse how to perform these manœuvres, for they must be continued twice a day for a considerable period, and apparent want of effect must not relax their efforts. In from three weeks to a month, if there be no signs of nervous or spinal irritation, localized electricity may be employed in the same way, *i. e.*, the limb being moved in the direction of the muscle stimulated. After a time it will generally be found that the flexors or extensors instead of becoming more

and more flabby as the limb is bent or straightened respectively, retain the same amount of resistancy in the different postures. This is a most hopeful sign, and when it occurs the child must be enticed and encouraged to try and move his leg in all the normal directions, and of course chiefly in that where power is most evidently deficient. Tickling the skin in the younger children, placing a ball for older ones to kick; a thousand games and devices may be invented on the spur of the moment to render these exercises full of childish fun and laughter.

At this time when power begins to return, and not before, tendency to distortion commences. This is primarily and chiefly manifested in the foot; but it affects also other parts,—for instance, the thigh and the hip, according to the extent of the paralysis. If the thigh and hip be affected, there is a remarkable tendency to turn the limb outward, the internal rotators and adductors seem chiefly weakened, so that while the infant lies in bed or sits on the lap, the whole limb falls outward, so much so that the sole of the foot

(also distorted) will face almost directly forwards. The muscles of the thigh chiefly affected or longest in recovering are the extensors, and children are frequently capable of all movements, except straightening the knee. The foot, under these circumstances, generally becomes varo-equinous, but sometimes a totally different or opposite deformation will occur.

All distortions of the foot are fully discussed in the sequel. We now have to deal with the conditions of thigh and leg in two phases of infancy, firstly, before the age at which the child ought to be able to walk, then at that period of life when he should, if healthy, be capable of running about. The exercises with shampooing, heat, &c., &c., above described are invaluable, but little will be effected by any method which does not enforce great attention to position while at rest. There is very little use in calling forth some feeble muscular contractions, if afterwards the limb is allowed to loll outwards, to drag on, and so stretch the weakened muscles. Therefore, the child must be watched, and in sitting or lying this

position must be fought against, and while in bed the limb should be supported by a bolster or pillow, so as to make it turn inwards rather than outwards. When in course of time it is observed that the sound limb has become so strong that the child endeavours to stand upon it, then he should be encouraged by the nurse holding him under the arms to put one leg before the other. If we could always have some one to aid in this way, we might advantageously abandon all other means of support. As, however, such constant supervision is impossible, there remains to us only to make judicious choice of such an instrument as shall aid and abet the weakened muscles without altogether superseding their action, as do the ordinary irons used for this purpose.

We have, in making our selection, to consider what it is that chiefly prevents walking, and we shall find two conditions at either extreme of the cases, which come under our notice. The one in which the feet and ankles fail, either from debility or deformity, to support the weight, the muscles of the thigh, being only so weak as to justify us in believing that if

facility for proper exercise be given, they will of themselves recover. The other, where the debility of the thigh is chiefly prominent. Of the former condition, it is only necessary to say here that the foot must be supported after the manner related in future chapters, the kind of appliance varying with the particular deformity developed.

The latter state requires further remark. In that condition the thigh is so weak that the hip-joint gives way in all directions as soon as weight falls upon it, and the knee bends, doubles up under the pressure of the body. Now the usual method of support is to attach a firm metal girdle round the waist, and from it to carry a steel rod down to the sole of the shoe, in which it is so fixed that when the sufferer is placed erect, the whole duty of support falls absolutely and entirely upon the metal. There can be, I conceive, no greater mistake than to override and abrogate entirely the function of the muscles. How great must be the restorative power of nature, which certainly does permit a small proportion of patients to get well even under

such obstructive means! Our object must be not to annul the necessity for muscular effort, not to render futile all attempt on the patient's part to support his own weight, but to assist his efforts to that just and fair degree which shall enable him, by the exercise of his feeble strength, to stand and walk, but shall, without some such aid on his own part, be insufficient to keep him erect. The instrument useful for this object may be varied in many ways. I will not here describe the form which I have devised, and which may be altered to suit different patients, since in the cases given at the end of this chapter a full description and plate of my mechanism is annexed, and it will serve as the basis upon which all such supports ought, I conceive, to be modelled.

It is only necessary for me to add that these cases are very protracted, and require great watchfulness as well as minute knowledge of muscular action; but if they come under notice sufficiently early, and have not been treated by methods which confine the muscles; they all of them are, in my experience, curable.

Case III.

Baroness von H. came from the neighbourhood of Stuttgart, in Germany, to consult me about her little boy, aged fourteen months, who, when nine months old, had been paralysed in the left leg; he was placed under my care May 25, 1864.

The boy is a large fat child, the limbs very big, even the diseased leg does not look to the eye by any means a shrivelled limb; little difference while it is at rest being perceptible to the sight alone between that and the sound one. The touch, however, finds the left buttock, thigh, and leg, flabby and soft, without any of that resiliency so characteristic of sound muscle. When he was placed on the sofa upon his back, the legs drawn down, and then the hold upon them suddenly relaxed, the right one would retain its position, that is the front would continue to face upwards, but as soon as the left one was released it would fall outward, so that the inner portion looked upward. The same disposition was more strongly remarked if the knees were bent close together, and the thighs drawn up so that the feet rested on the couch not far from the buttocks; then as soon as support was removed, the left knee lapsed outward, and the whole limb fell with its outer aspect on the couch.

On supporting the child and encouraging its efforts to walk, the left leg was found entirely useless; when the body, resting on the right leg, was pushed forward, the limb merely swung by its own weight, and then, while still the body was inclined in front, the left thigh sustained no weight; the hip yielded outward or inward,

the knee bent, the foot turned inward, the outside coming to the ground.

When the infant was seated on a chair, and asked, while the thigh was fixed, to raise the foot, he could not so straighten the knee as to do so; but would, when the thigh was released, rotate it outward, and then raise the whole limb from the hip.

All the muscles of the limb, therefore, were paralysed, with the exception of the psoas and iliacus, which did not appear to have lost power, the glutei, tensor vaginæ, rotating muscles, also the flexors of the leg were extremely feeble, the extensors appeared utterly powerless.

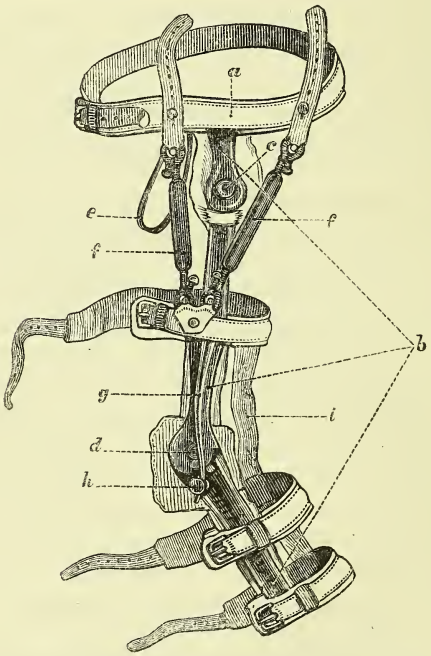
The foot, even when the child was seated, was turned inward and downward (equino varus), but it could be placed in nearly normal posture with the hand; when the foot was on the ground (the body supported by the nurse), the foot bent quite round, so that the sole looked inward and backward, the outer side of the ball of the little toe touching the floor.

The ordinances to which the child was submitted were designed with a two-fold object: the first to prevent degeneration of muscle, the second to recall power. To fulfil the first he was ordered tonics, cold bathing, followed by rapid frictions, galvanism; and the nurse, as well as Madame von H——, were shown the various passive movements most desirable, and the proper method of shampooing.

In order to fulfil the second object, it was first of all necessary to provide some form of support, and, above all, necessary to render that support such as would only aid—not override and supersede—the action of muscles.

An iron affixed to the waist and the shoe performs this latter act to perfection, and renders all muscular effort to support the body superfluous. The instrument which I have devised, and used also in other cases, is depicted; I will now explain its object.

FIG. IV.



A SPLINT FOR A PARALYZED THIGH AND LEG.

a, Waistband; *b*, upright rods; *c*, hinge at hip; *d*, hinge at knee *e*, small cord representing perineal band; *f*, india-rubber springs; *g*, steel spring acting on nut *h*, and pressing lowest rod forward; *i*, portion for inner side of thigh.

When the weight of the body falls upon a limb in the state above described, every one of the joints yield; the hip gives sometimes inwards, sometimes outwards, and nearly always forwards (the psoas prevents the over-extension of the joint). The knee bends, and the foot turns inwards. The instrument consists of a strap which goes round the pelvis, one-third of its circumference being made of steel covered with leather, to which is sewn a strap attaching a round, soft perineal band. The steel belt bears a short rod of the same metal, and of such length that its lower end lies over the great trochanter; to this end is hinged another rod which reaches the knee, and to this a third—extending half-way down the leg. Two metal hoops on the thigh piece, and two on the leg piece run round the back of the limb and attach to these outer rods two similar ones on the inside, thus forming cradles on which the thigh and leg rest. Now, in these metals we have no restraining or supporting power, save some check to abduction and rotation of the thigh; the force in question has now to be added in a manner permitting of graduation. There may be seen attached to the thigh-rod, about an inch below the hinge, at the hip joint, the lower end of two india-rubber springs, whose upper extremities are attached to straps provided with button-holes. On the pelvis belt there are two buttons, one in front, and one behind its junction with the upright rod. These receive the straps of the caoutchouc springs at any degree of tension that is found desirable. At the back of the knee-hinge is a spring, playing upon a nut, and provided with a mechanism for the regulation of its power. The value of this instrument is called into play by careful adapta-

tion of the spring force to the muscular weakness; such tension should be given to the springs as will not support the body without some aid from the muscles, but with that aid will keep the limb from giving.

When this instrument was made, I applied to the foot the internal tibial supplying a spring of three ounces power; I also placed a spring to represent the peroneus tertius, giving, however, but very little tension. The two springs were so regulated as to keep the foot straight while weight was upon it.

In a short time the limb was visibly improved, the child could throw it forward, and walk with very little support.

12th July. The child now walks so well that the instrument is discontinued, but the foot still requires support.

At the beginning of September the ankle had sufficiently regained power to be left without support. The same regulations with regard to bathing, electricity, &c., were continued.

At the beginning of 1865, the lady returned to the Continent with her son, he then walked very well, the only appearance of lameness being that the foot and knee turned out more than the other. This, although always the last portion of awkwardness that will yield, appears, in the present instance, chiefly due to habit, since he can, when watched and checked, walk in a perfectly normal manner.

The following case is related as showing the value of movement in paralytic cases.

I simply fulfilled the indication of placing the patient in a position to use the muscles :

Case IV.

Miss E. B——, aged two and a half years, was brought to me from the North of England, 11th November, 1864, with the following history : She was always a weakly child, but when about ten months old appeared to have lost power from the hips downwards. After a week or ten days some power returned, and then she began to get rapidly better; at the age of eighteen months, her parents and nurse tried to teach her to walk, but she was very timid, required much support, and her feet began to deform themselves, the toes became pointed, and the sole turned in ; at last she screamed so violently when they tried to make her walk, all the joints yielded so completely, and the girl was so frightened, that the attempt was postponed : but she only became weaker and the feet more turned.

I found on examination that the whole muscular system was very feeble, but chiefly from the loins downward and inclusive ; at the same time the head and abdomen were large, and the child was heavy. The spine straight, both feet equino-varous; the left most varous, the right most equinous. The child was very timid and sensitive, would not be placed on the feet without crying, but liked best to crawl on the floor with the loins and back bent.

There is little use in detailing the weekly changes in a long case. I supplied the posterior tibial in the left foot, the anterior tibial and peroneus tertius in the right. The patient was under my care until the 7th of March,

and during this interval slight changes were made in the position of the springs as occasion might require. Very soon after the commencement of treatment she began to get on her feet of her own accord, and she was gradually and slowly taught to walk. At the above date she left London with very little support indeed, and able to walk tolerably well. No other treatment save tonics was employed.

CHAPTER VII.

FLAT FOOT.

The feet of infants have, unless distorted, very little arch—that is to say, the line from the heel to the ball of the great toe is nearly straight; but when the child begins to walk, the arch should normally rise. This change is brought about by the combination of two modifications of posture. Before walking, the outer border of the infantile foot lies very much below the inner; when walking begins, the front half of the foot is rotated so as to bring the inner border lower, and at the same time, the head of the first metatarsal bone (*i.e.*, the ball of the great toe), is depressed by the very muscle whose outward rotating action was called into play by the act of

walking.* Sometimes, however, the middle, the waist of the foot, falls during this outward rotation, and the child's foot, instead of becoming more bowed, becomes flat, and in these comparatively rare cases the defect was in all probability congenital.

The deformity, however, is much more frequent later in life, resulting from yielding of the muscles, which ought to support the arch of the foot. This failure is very frequently due to over exertion; hence, flat foot is a commoner deformity among the poor than the wealthy; among the lymphatic and melancholy than among the sanguine temperaments. There are, however, a good many

* The peroneus longus muscle has been shown by M. Duchenne, of Boulogne, to depress the head of the first metatarsal bone, and many continental writers have argued that, therefore, flat-foot arises from weakness of this muscle. They appear to have disregarded the other actions of the organ. If their argument were correct, flat foot would always be combined with inward rotation, but the contrary position is that assumed. The fact is, that to permit the peroneus longus to depress the head of the bone it is necessary that the base be supported. The lever is one of the third order, the power (insertion of peroneus longus) lying between the fulcrum (base of bone) and the weight (head of bone); but in this class of lever, if the fulcrum give way, the weight end becomes fulcrum, and the power acts on what ought to have been the fixed point.

persons in the middle and upper classes with a tendency to this malady, who, when getting into years, or suffering from general debility, feel its peculiar ill effects, namely, a want of

FIG. V.

FLAT FOOT SEEN FROM THE FRONT.

The twist inwards of the anterior half of the foot, and the giving way of the instep, are well shown.

flexibility and power in the limb; they complain, in fact, of getting whole-footed, and more especially of a severe pain at the inner

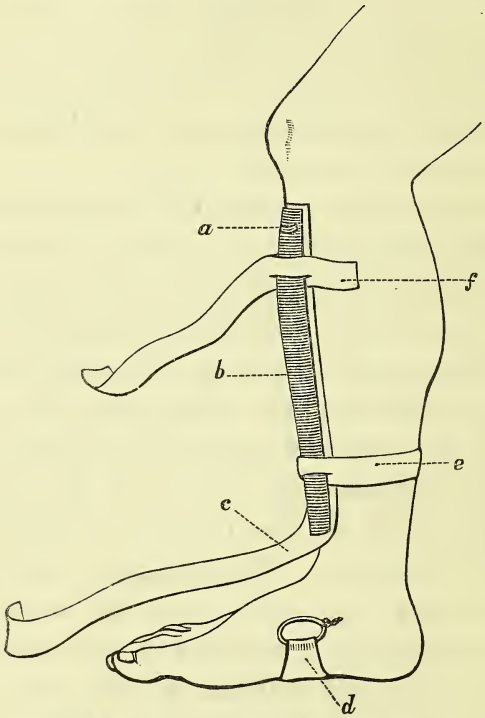
side of the arch of the foot in the situation of the navicular. This pain, which generally increases as the case goes on, becoming at last very severe, is usually ascribed to the tightness of the plantar fascia through flattening out of the arch. It is curious that anatomists with the same breath attribute to that fascia the duty of keeping up the arch of the foot. If the plantar fascia keep up the pedal arch, it must always be on the stretch, without the production of pain, and if it fail to do its duty, and let the sole become flat, there would be absolutely less tension, and therefore less of such cause for pain. But the fact is, the sinking of the plantar arch depends on debility of the anterior tibial muscle, the pain is caused by unaccustomed parts coming to the ground; and more particularly by the scaphoid and inner cuneiform falling sufficiently low to compress between themselves and the ground the large internal plantar nerve, just at its subdivision. Another office of this muscle is to keep the front half of the foot in such position as to cause the weight to fall rather on the outer side of the sole. This

part of its action is antagonized by one of the duties of the peroneus longus. Thus, when the anterior tibial fails, there follows depression of the cuneiform and base of the metatarsal bones, together with a certain amount of outward rotation, furnishing a further proof of the truth of my assertion concerning the action of this muscle.

I wish to draw a strong distinction between true flat foot, as above described, and the less severe forms of valgus, which, although often mistaken one for another, are very different in character and causation. In flat foot, the pain is situated at the inner side of the sole under the scaphoid bone; in valgus, the patient complains of pain over the upper posterior part of the cuboid, and extensor brevis digitorum. The misshapen enlargement at the inner side of the foot is in the former malady less posterior in position than in the latter, not muffling or concealing the inner malleolus. Although in the former, the inner border may be too straight, *i.e.*, not sufficiently concave, yet the outer border preserves its convexity. (Plate ii.) The pain and

awkwardness in walking is more strongly marked than in the slighter forms of valgus.

FIG. VI.



COMMENCEMENT OF THE APPLICATION FOR FLAT FOOT.

d, A trapezoid piece of plaister into which a loop of copper wire has been fixed, adhering to the sole of the foot, to act as the insertion of tibialis anticus tendon; *c*, a strip of strapping adherent over the anterior tibial muscle (it is represented too straight along the bone), and having its lower end hanging down more than the length of the limb; *b*, a piece of tin carrying a wire loop (*a*); *e*, *f*, circular strapping split to receive tin.

Now it is evident, that both these malpostures (depression of the arch and outward rotation of the front of the foot), being produced by one deficiency, are to be remedied by supplying that deficiency; namely, by some force imitative of the anterior tibial muscle. First, a trapezoid piece of plaister * is made to adhere with its broader portion to the inner side of the sole of the foot over the cuneiform and head of the first metatarsal bone, and extending beyond their outer edge, even to the outer side of the foot. The direction of this plaister must be the same as the internal tibial tendon, the narrower part should terminate upon the inside of the foot, just in front of the inner malleolus. This end is not to adhere to the skin, but is to be doubled down, sticky sides together, and into the fold is to be sewn a piece of copper wire (gauge 17). (Fig. vi. *d*.) The foot is now to be held by an assistant as nearly as possible in the proper position, and to be evenly strapped

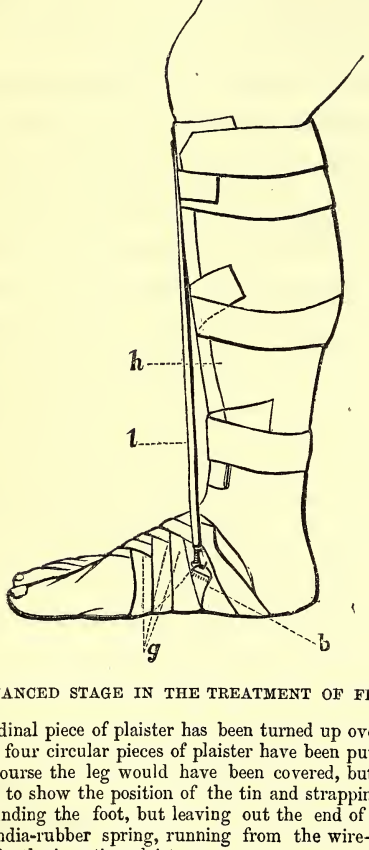
* It must be understood that the plaister used is to be the emplastrum resinæ, spread upon a strong twilled calico, and all strips from it must be cut *lengthwise*, the irregular-shaped pieces as much so as possible.

from before backward, leaving out the end of plaister, into which the wire-loop was sewn.

We now turn to the leg. A piece of strapping, from three-quarters of an inch to an inch broad, not quite three times as long as the distance from below the knee to the ankle, is made to stick firmly over the course of the anterior tibial muscle, upon whose origin one of the ends lies, the other hanging loose below the foot. The surgeon must be provided with a piece of tin rather narrower than the long piece of strapping, and long enough to reach from the tuberosity of the tibia to a short distance above the ankle-joint. This tin by means of two holes in its upper part, supports a wire loop, and it is to be bent into a concave shape, and be twisted a little so as to fit roughly over the surface of the muscle. Before fixing the tin in its place, it is to be inserted into slits only just long enough to receive the tin, which are made in two pieces of plaister, one long enough to encircle the upper, one the lower part of the leg. It is safer to give the lower end of the tin a little inclination outwards, so that any force, subsequently to be exerted,

may not press its edge against the shin. The

FIG. VII.



AN ADVANCED STAGE IN THE TREATMENT OF FLAT FOOT.

The longitudinal piece of plaister has been turned up over the lower end of the tin, and four circular pieces of plaister have been put on the leg. In the ordinary course the leg would have been covered, but it is here left partially bare, to show the position of the tin and strapping. *g*, strips of plaister surrounding the foot, but leaving out the end of *b*, with its wire loop; *l*, an india-rubber spring, running from the wire-loop in the tin above to that in the insertion plaister.

piece of tin is to be laid upon the longitudinal strapping. The slit pieces are made to adhere round the upper part of the leg and the ankle respectively; the lower end of the long piece is to be turned up over the metal, and held there while the leg is carefully strapped from below upwards. At the top of the tin a hole must be made in the strapping to permit the wire loop to come through, and I must caution the surgeon that it is necessary to fasten down with the strapping the little end of tin, which extends beyond the loop. There remains an additional length of the longitudinal piece of plaister now lying above the rest of the appliance; this may be brought down, and for more security, made to lie on the outside of the circular strips. It will be perceived, that the longitudinal piece of strapping is arranged in certain folds as follows:—It first adheres to the skin of the leg, then turning upwards forms a loop round the lower end of the tin, running up with its sticky side outward, and adherent to the inner surface of the circular strips; it thence turns round over the last transverse piece, and is brought down

on the outside. By this means we have established at the upper part of the leg, on the origin of the muscle to be supplied, a fixed point—the wire eye supported through the medium of the tin by a loop of plaister, which takes its bearing in such a manner that no constriction of the limb can be produced, whatever downward force be exerted on the wire.

At the same time, the slit pieces through which the tin passes and which encircle the leg, entirely prevent any lateral movement. In fact, as a medical man watching me adapting this mechanism, observed, "You make a new bone outside, and then you fix muscles upon it."

The muscle or muscles to be fixed, consist of india-rubber springs, those which I myself employ are made in my own establishment; but good springs of a rather different construction can be procured at india-rubber shops.* They should be made of $\frac{1}{4}$-inch cord, and should vary in length from an inch upward. The manufactured ones have their ends bound with string and turned into loops. The mode of applying the spring is as follows:—The

* They are manufactured by Mr. Hodges, Southampton Row.

copper wire sewn into the plaister of insertion is to be passed through the lower loop and its ends twisted firmly together. A double or S-shaped hook made of steel wire (gauge about 57), has one end passed into the upper loop of the india-rubber, and if the spring be long enough, the other curve of the S may be hooked upon the wire of origin at the upper end of the tin. There is in this mode of fastening some difficulty in adapting a spring of such length as shall exercise sufficient, but not too great, tension. Moreover, it may be desirable to lessen the tractile force at night. In order to facilitate these measures, the following plan is recommended as being very simple and effective :—A small brass chain about $1\frac{1}{2}$ inches long, or more, is fastened by opening and reclosing a terminal link upon the wire of origin, and into any of the other links the hook on the india-rubber may be inserted. This method for which I am indebted to a lady, aunt of one of my patients, enables us to vary the tension exercised with the greatest ease. I need now only remind the surgeon how very desirable it is not to

begin too violently, and also that he must put on the plaister as smoothly as possible; any folds in the part, for instance, that represents the insertion of the tendon, would cut into the skin, and necessitate interruption of the treatment.

If, however, the application have been well managed, patients with this sort of deformity will experience immediate relief, and those who limp into the room will walk out again upright, and with ease. Of course the malady is not thus instantly cured; the use of the apparatus must be continued for some little time, and a tighter spring must be substituted in a week or ten days. The general health must be attended to. Iron, quinine, or other tonics, generous diet, cold bathing, &c., are to be enforced. As the muscle gains strength, it naturally shortens itself to the improved position in which the india-rubber keeps the foot. The sole regains more and more its normal curve, and though at first the arch will fall again when the appliance is removed, and the patient throws his weight upon the limb, yet in about a month it acquires suffi-

cient power to support the body without yielding.

The length of time which may be necessary for the cure of this deformity depends very much on the state of the general health as well as upon the local conditions. Unless, however, there be some weakening drain upon the system, irredeemably vicious habits, or constitutional cachexia, three months should suffice to overcome the malposture in the adult, less time in the young subject, rather more in the old. When the origin of the disease is abrupt, occurring about the time of puberty, generally as the body is assuming an over-rapid growth, and is considerably debilitated, the conditions of absolute cure are somewhat different. As long as debility remains, it is not safe to leave the patient without some support, even although immediately after removal of the appliance the foot may remain perfectly symmetrical; for under such unfavourable circumstances a relapse is likely to occur. If, however, the foot be reduced to its normal form, and, by means of treatment or otherwise, strength have been restored, the

apparatus may be discontinued, even although it may have been employed for only a few weeks. In these debilitated cases the treatment saves much suffering, and often prevents permanent lameness, or at least awkwardness of gait.

Case V.

Ellen M——, aged fourteen, a stout girl, large for her age, was brought to me, October 19, 1863, suffering from increasing pain at the inner side of the sole of the foot when placed on the ground; at the same time she became more and more lame and awkward in gait from stiffness and difficulty in lifting the front of the foot.

On examination I found the foot to be flat, the sole lying straight along the ground, the instep less prominent than on the other side; and a bulging inward behind the base of the first metatarsal bone.

I supplied the anterior tibial muscle as shown at figs. vi. vii. She lost at once the pain under the inner cuneiform when throwing weight on the foot.

27th Nov.—The appliance re-adjusted once between this date and the last. She proposes to return to service, which she had left on account of lameness. Re-applied the strapping, &c.

6th Jan. 1864.—The girl has been to the hospital twice since last report. She considers herself well; the foot is not very beautiful in form, but is nearly as good as the other. Apparatus re-applied, and she was told to return in three months.

7th April.—The patient came to return the spring, &c.

and to report that she has suffered no inconvenience since the last application, which remained on the foot for more than a fortnight.

Case VI.

George T——, aged twelve, was brought to me at the Charing Cross Hospital, with the condition of foot shown at plate ii., 30th May, 1864. He is an errand-boy, but has now so much pain and difficulty in walking that he can hardly follow his occupation.*

In this case springs in the place and direction of the anterior tibial muscles were supplied.

15th June.—The boy has been doing his errands, having had full as much work, with far greater ease; the foot portion has been renewed once since the last date.

20th July.—The feet have much improved in appearance. The patient walks with perfect ease.

19th August.—Discharged, at his own request, cured. He was ordered to return and report himself in three months.

11th October.—The lad remains well; there is no tendency whatever to relapse.

* I would call especial attention to the difference between this deformity (true flat-foot) and a slight degree of varus, as depicted at plate ii., and at plates iii. and iv.

CHAPTER VIII.

TALIPES VALGUS.

TALIPES valgus occurs in many different degrees, and its lesser stages are, as a rule, confounded with "flat-foot," although the deformities are essentially different.

The feet of women incline normally more towards the valgous form than those of men; when viewed from behind it is perceptible that a woman's heel slopes a little outward from a point below the level of the ankle, while the depression beneath the inner malleolus, well marked in the well-formed male foot, is in the female much more filled out. This results from peculiarity of form in the joint between calcaneum and astragalus, which causes the former bone to be in a position of greater

rotation outwards; also from certain slight differences in the form of other tarsal articulations.

Valgus appears as a congenital disease more frequently than equinus, less frequently, probably, than varus. I say probably, because there is considerable peculiarity in the healthy feet of infants, namely, a great tendency to turn the sole inwards, so that the outside of the foot looks directly downwards;* but when the child begins to walk, the very pressure of the body places the foot in the proper posture. Yet I have been occasionally consulted by anxious mothers who have imagined this natural tendency of the child to be a real distortion. If, on the other hand, the tendency of an infant be to turn the foot rather outward—to hold it straight—no anxiety is produced; indeed the position may be admired as "a pretty way the baby has with its feet;" although, in fact, the condition is a congenital valgus, which will get worse and more marked when the child begins to walk.

In its worst degrees this deformity, whether

* *See* Talipes Varus.

congenital or acquired, is not common; but its slighter degrees are of frequent occurrence. The patient complains that walking or standing on the foot causes considerable pain at the instep, in front of the outer malleolus, and, in the more severe forms, of great pain at the sole; there is a peculiar whole-footed gait with an out-turned foot, and a very awkward limp; indeed we may here observe, that a not very severe valgus will cause more pain and awkwardness than an equal or higher degree of any other deformity.

A view of the foot from the front shows a flattened, broad instep, both the arch and the waist having very much disappeared. The inner malleolus hardly projects; that is, the outline of the leg above is natural, and the prominence of the inner ankle, therefore, properly marked in that direction; but the depression beneath that bone is filled out so as to muffle and conceal the projection from below. This swelling is not like that of flat-foot, whose axis is directed from before backwards, and whose greatest prominence is a little behind the base of the metatarsal bone

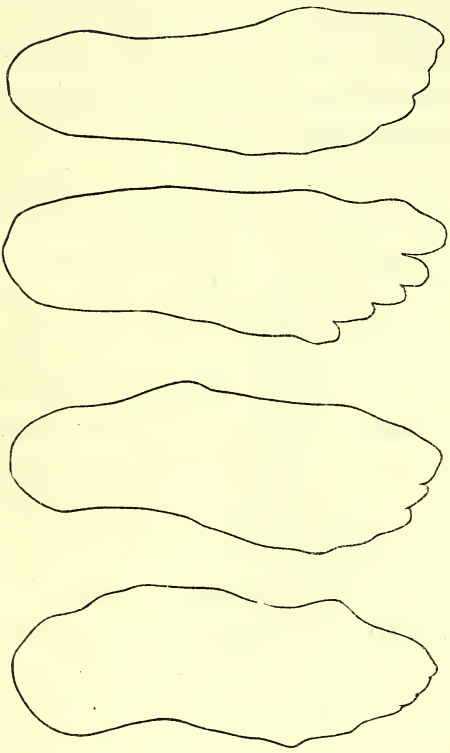
(page 89); on the contrary, the swelling in question extends from the malleolus downwards and a little forwards; its greatest prominence is generally midway between the inner ankle and the ground, but in the severest cases is lower.

The front half of the foot and the toes point outwards, the weight of the body falling too much on the inside of the ball of the great toe.

Seen from behind, the bulging below the inner ankle is strongly marked, and the two parts which constitute the enlargement beneath that bone are frequently quite visible. (Plate iv.) The line of the tendo Achilles is no longer straight, but describes a curve whose concavity looks outwards, showing that the point of the os calcis has deviated in that direction. The patient walks, moreover, too much on the inside of the heel.

Thus, it is evident, since both the front and the back of the foot have yielded outwards, that the axis of the member no longer forms one straight line, but an angle situated at the medio-tarsal joint. The foot, therefore, seen

FIG. VIII.



OUTLINES OF FOOT.—NORMAL, AND IN DIFFERENT STAGES OF VALGUS.

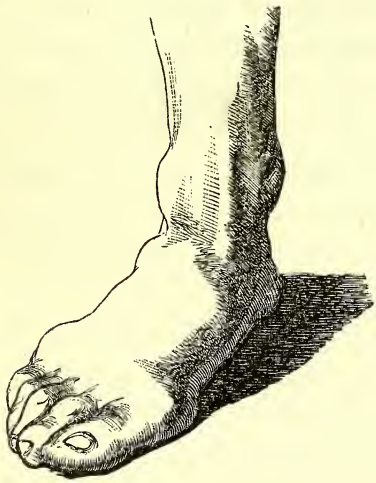
from above, is no longer convex on the outer, concave on the inner edge, but the reverse, the outer surface is concave—the inner convex. The outlines on the preceding page are diminished from tracings made in the ordinary way; the feet being placed upon paper, and a pencil drawn round them.

In very severe cases the retreating angle is so marked that the joint surface of the os calcis and the cuboid becomes worn down, and the former bone forms a new joint with the fibula. The scaphoid bone yields so much outward as to leave a considerable portion of the head of the astragalus bare at the inner side. The change in the position of the os calcis takes place at the joint between that bone and the astragalus. This latter, as we know (p. 2), is not capable of sideways movement or rotation, but the stress put upon it laterally—by the dragging of the other bones—causes it very much to look in the mortoise-like joint of the ankle, as a drawer will get fixed if it be pulled upon unequally. Hence, in all these cases, the ankle-joint is very stiff and inflexible.

These manifold distortions arise primarily

from paralysis or debility of the posterior tibial muscle, whose tendon has a very wide insertion at the sole of the foot; its chief power is exercised on the scaphoid bone, but it also stretches across the foot to the outer cuneiform, cuboid and fourth metatarsal bones. This muscle keeps the front of the foot from

FIG. IX.



AN ACQUIRED VALGUS.

The posterior tibial muscle is quite paralysed; the anterior has some power remaining, but not enough to keep up unassisted the arch of the foot; the stretching of the muscle produced by the falling in of the tarsal bones causes the tendon to project.

turning out from both abduction and outward rotation, and preserves it in a position that shall cause the weight to fall chiefly on the outer aspect of the sole. Part of this action is assisted by the anterior tibial, and when the posterior has given way that muscle strives to supply its place. The accompanying cut (Fig. ix) shows a degree of valgus in which the anterior tibial is still sound, and taking upon itself violent action to supply the place of the paralysed posterior organ; hence the great prominence of its tendon. After a time, however, this muscle, inadequate to support the increased labour, becomes stretched, and also loses power; therefore in cases of severe valgus both muscles are debilitated.*

* It is astonishing to observe that orthopædic works should advise the division of this tendon for the cure of valgus. It is in great measure upon retention or recovery of power in this muscle that we must rely for restoration of position. We have already seen the effect of this treatment, even as described by a fautor of the method: and, after cutting away one of the muscles which keeps up the key-stone of the foot's arch, while the other is paralysed, there will naturally be "considerable difficulty in continuing sufficient support to the arch of the foot, and even after the arch has been restored, support has to be continued for many months" (*see* p. 31). Support, in this language, always means irons.

But the posterior tibial muscle has still another attachment and action of very great importance. The great bulk of the tendon, inserted into a tuberosity on the lower and inner edge of the scaphoid, throws off, some distance before reaching its destination, a strong cord of fibres which runs backward and outward to the bottom and inner side of the os calcis. When the muscle contracts, as it always does in health, as weight falls on the foot, this slip of tendon is tightened, and prevents the heel rolling outward. But when the muscle is paralysed it can no longer exercise the power either of keeping the front of the foot or the heel from outward deviation, we therefore find in such cases that particular position, that remarkable break in the axis of the limb, so characteristic of valgus, and which could not possibly be produced by the spastic contraction of any muscle or muscles if the posterior tibial remained sound.

It has been already stated that the distortion now under consideration produces more pain and lameness than a similar degree of any other deformity. This is partly to be

explained by the stiffness of the ankle-joint above mentioned, and partly by the very insecure basis upon which the weight falls, chiefly the talo-scaphoid joint, and by the implication of the plantar nerves pressed upon more or less in progression. It should also be remarked that since the ankle-joint is so immovable, the foot has no choice as to the place where the stress shall fall. The inside of the heel receives the weight first, and as in the act of walking the body advances, the point of support passes forwards, occupying heel, scaphoid, and cuneiform; lastly the head of inner metatarsal bone (the inner side of the ball of the foot) and the large toe, so that every point from the heel to the toe-nail is pressed outwards, and every part capable of yielding in that direction gives way. Hence, even in the earlier stages, valgus is a deformity which, if allowed to continue, must increase with exercise. We see many cripples about the world with the foot turned out, the leg shrivelled, and the whole body rendered crooked by their limping walk, who might have been enjoying their cricket or their

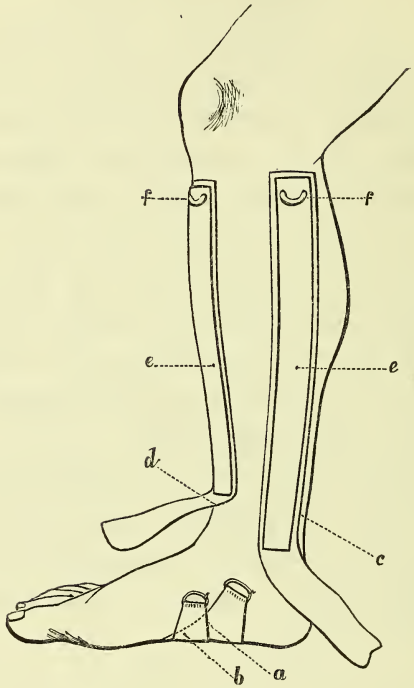
shooting if the increasing nature of their malady had been early understood.

The same means, viz., substitution of a power for the weakened muscular force must be employed in these as in the last described distortion. In the worst cases, both anterior and posterior tibial muscles must be reinforced, in less severe forms of the malady the posterior alone may be supplied; the mode of application for the anterior muscle has been described, we will now relate the method of applying the posterior, and the surgeon may use one or both as he sees fit.

A longitudinal piece of plaister is to be placed along the posterior edge of the tibia, and upon it a strip of tin provided with a wire loop, and carefully curved to fit the surface on which it is to rest.

Pieces of plaister intended to encircle the leg are slit in the proper places and to the proper amount to receive both slips of tin (in case both muscles are to be aided), they are then applied in such wise that one piece adheres to the upper part of the leg the other to the lower.

FIG. X.



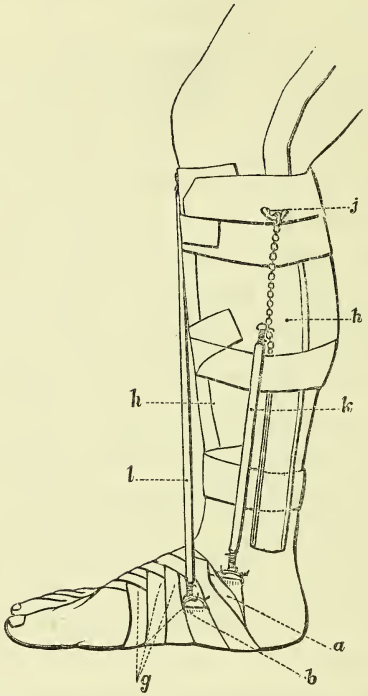
THE FIRST STEPS IN THE TREATMENT OF VALGUS.

a, A trapezoid piece of plaister, with a wire loop in its upper end, adherent to the foot in the position of the tibialis posticus tendon; *b*, a similar piece, adherent to the foot over the former, to supply the place of the tibialis anticus tendon; *c*, a broad and long piece of strapping adhering over the tibialis posticus muscle. The rest, nearly twice the length of the limb, hangs freely down; *d*, a similar piece of strapping, applied in a like manner over the tibialis anticus muscle; *e*, *e*, pieces of tinned iron laid upon the strapping at *c* and *d*, and roughly moulded to fit the surface; *f*, *f*, wire loops fixed in the upper part of each piece of tin.

The piece of strapping upon the foot which represents the insertion of the muscle requires very careful arrangement. The principal tendon runs forward, and a little more downward, than a line drawn from the bottom of the inner malleolus to the ball of the great toe; it is inserted into the inferior aspect of the scaphoid, and of the internal cuneiform bone; this part of the tendon is very thick and strong, and there run from it several slips, one across the foot to the outer cuneiform, another to the fourth metatarsal bone, and one piece turns back to the os calcis. Thus, a peculiarly broad attachment must be imitated, and the plaister, which should always be larger than the mere attachment of the tendon, is to be cut to that irregular rhomboid form which will best represent the shape of the insertion; the acutest angle is to be truncated, the plaister turned down, and this part, having a piece of copper wire sewn into it as described in the last chapter, is suffered to lie on the side of the foot below the inner ankle.

Take care that the plaister is cut in such manner that this anterior edge runs length-

FIG. XI.



AN ADVANCED STAGE IN THE TREATMENT OF VALGUS.

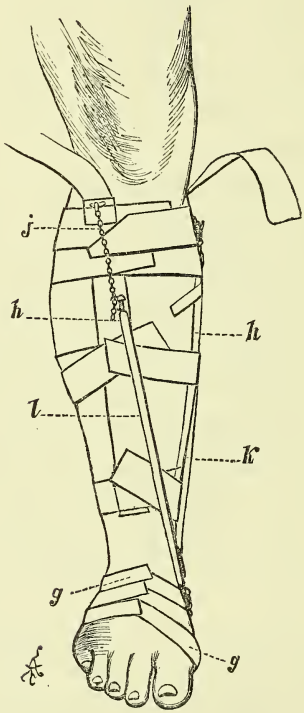
Circular strapping has been applied to the foot, and in part to the leg; but only three such strips are shown in the diagram, that the arrangements may not be concealed. *g*, circular strips of plaister on the foot; *h*, *h*, arrangement of the longitudinal strips, the ends which hung loose in Fig. vii. are now turned up, and lie on the tin, sticky sides outwards; *k*, india-rubber spring to represent posterior tibial; *l*, india-rubber spring to represent anterior tibial.

wise along the threads of the calico; thus it will not yield, and is firmer than when formed in any other manner. Every woman at all accustomed to needlework or to "cutting out" knows the object of shaping certain parts "on the straight." Other parts must be pulled out with the hand till they have been stretched to their utmost.

The next point is the selection of springs of proper length: this is a matter in which experience soon directs us to make an almost unerring choice; but the following rules may be taken as guides: never to put on too short a spring at first; to select, as a rule, the stronger and the shorter spring for the stronger muscle. When, as in this case, there are two springs to be applied, the stronger one should be put on first, but its effect must not be estimated until both have been for some time *in situ*, when the position may be examined. We are not to expect that the posture will be entirely corrected at once, power sufficient to do this would be utterly unbearable; but the correction of one part of the deformity should be proportional to that of the other; a little

experience in the treatment of these cases soon teaches the recognition of this relative

FIG. XII.



AN ADVANCED STAGE IN THE TREATMENT OF VALGUS (SEEN FROM THE FRONT).

The superfluous ends of the longitudinal pieces of plaister project on each side of the knee; the lettering is identical.

correction. To aid his judgment, the surgeon should in every case, after the springs have been on for some time, pull a little upward upon the one that seems not sufficiently to correct its part of the deformity, a little downwards upon the other, until he finds wherein any possible error chiefly lies.

It will in all probability be desirable to renew the whole application in about ten days or a fortnight; but it may be advisable to change that on the foot sooner, since the constant drag on the insertion plaisters has a tendency to loosen them; but they ought certainly to remain a week. At the end of that time a considerable change will have taken place in the form of the foot, and it will probably be evident that on the next dressing one of the forces must be relatively increased and one diminished. This is always extremely easy, but the same care must be again taken in judging the proper relation of the two forces.

Some difference exists in the form of valgous feet, according as the peronei assume almost the entire governance of the limb, or

as the sural muscles act more or less powerfully upon it, and this variation has given rise to the name of *equino valgus* for the latter condition. It is a matter of very little importance in a practical view, whether or not a little drawing up of the os calcis be present. In such cases a stronger spring for the anterior tibial must be used.

If the patient be of age to walk, it is desirable from the first not to keep him in bed. Our hopes of a permanent cure without any lameness depend upon the muscles regaining such power as to act sufficiently strongly, to retain of themselves the foot in its proper place. The paralysis in children does not continue total for any great length of time, but the muscle is very much weakened, and it is only by exercise that its strength can be restored.

I must repeat that fatty degeneration is the common cause why children's limbs that have been paralysed do not regain their power, and that to prevent such disorganization exercise is of the utmost importance. But if the limb be confined in a stiff metal shoe, which of

course prevents the action of all muscle passing to the sole, if the foot be laced into a boot with an iron to prevent lateral movement, or if any of those inflexible rods euphuistically called "supports" are fastened on the limb, fatty degeneration is as certain as the best possible assistance can make it.

Case VII.

Miss Louisa T—, aged 16, was brought to me February 18th, 1864, suffering from pain and deformity in the right foot.

For some two months or ten weeks past, the young lady's mother has remarked a little awkwardness of gait, and that the right foot turns out more than the left, more so than it did previously; therefore about a week ago, as pain had been complained of, she examined it, and observed that it appeared clumsy in shape. The patient had grown very much in the preceding year, and is somewhat anæmic.

Miss T. complains that for some months past she has been conscious of an awkwardness in the right foot, that it was not flexible, and felt heavy; this she at first attributed to her boots; but in spite of changing them she found the inconvenience increase, the ankle-joint appeared to become stiff; she could not raise herself on the toe of that foot as on the other. During the last three weeks the foot has become painful, the pain being situated rather on the outside of the instep, a little in front of the ankle-joint.

On examining the foot, I found all the signs of a moderate degree of valgus,* whose signs have already been amply described.

I supplied the posterior tibial muscle with but little tension of the spring, and caused her to walk about in my consulting-room. She stated the pain to be less.

14th March.—I have seen the patient twice since the last report; once to make a trifling alteration, once to renew the plaister on the foot only. The condition is a good deal improved; the foot can now be easily brought into very fair shape with the hands.

29th April.—No pain is now complained of, and the patient can raise herself on the toes of that foot, but still with a little more difficulty than on the left. The ankle is more flexible, but the medio-tarsal joint is now too loose, as is generally the condition when these cases have been improved.

27th June.—The case may now be considered well; the foot is restored to symmetry; the tumefaction under the inner malleolus has disappeared. The medio-tarsal joint is but very little looser than that on the other side. For greater security she was desired to have the sole thickened on the inner side of the boot. It should be mentioned that during the treatment, tonics, principally iron, were administered.

In April, 1865, I heard that this patient remained quite well and active.

Case VIII.

E. W., aged 27, came under my care as an out-patient at the Charing-cross Hospital, June 16, 1864, com-

* The second figure on page 105 was traced from this foot.

PLATE III.

18th February, 1864.

PLATE IV.

18th February, 1864.

To face page 120.

Talipes Valgus.

plaining of increasing lameness of the right foot. She was in service, having a hard place, and the lameness had been coming on for more than four years.

On examination I found both feet valgous, the right one but very slightly; and the patient experienced no inconvenience from it. Considerable pain was complained of, chiefly over the outer instep of the left foot; at the same time she described the particular form of lameness, so often mentioned. On the above date, therefore, I supplied both the anterior and posterior tibial muscles.

22nd August.—The progress is in this case well marked, the foot is much improved, and the muscles of the leg are well developed. She has left service, and got some more sedentary occupation, but where she has still sufficient exercise.

7th October.—There has been nothing but progress to report. The plaister on the foot has been renewed about every fortnight, that on the leg about once in a month or six weeks. The case is now well; the greater stoutness and plumpness of the leg is in part to be attributed to better food and less work; the patient has altogether become much fatter.

Case IX.

L. C., a girl, aged 18, was brought to me February 18, 1864, suffering from a deformity and pain in the left foot.

Seen from the front, it is at once observable, that there is apparent enlargement (from position) of the parts below the inner malleolus, so that they actually project

beyond, and muffle, as it were, its natural prominence. Looked at from above the inner border of the foot is found somewhat convex, the greatest protuberance being below, and but very little in front of the inner malleolus; the outer border of the foot is concave, there being an obtuse retreating angle about half-way between the heel and little toe. Viewed from behind the enlargement, below the inner malleolus, is even more strongly marked, and that portion of the tibia is too little perceptible; also a greater amount than normal of the outer border of the foot is visible.

The patient complains that walking and standing cause considerable pain in the outer part of the instep, over the calcaneo-cuboid joint, and flexor brevis digitorum muscles. This pain is very severe, she is not able to walk as she could a short time ago, and she is conscious of an awkward-looking and uncomfortable lameness. The case is an acquired valgus of advanced degree. (Plates iii. and iv.) The third figure, p. 105, is the outline of this foot.

I supplied the posterior tibial tendon, with but little force, and made her walk about my room; she said that there was much less pain on the instep.

14th March.—The patient has returned twice since the above date. The foot very much improved; it can now be brought into very fair shape with the hands.

29th April.—My pupils have attended mainly to this case, I only seeing it and giving directions. The whole position is very much better; but there is that looseness at the medio-tarsal joint, which in these cases always follows restored position; the spring is to be continued with less force.

PLATE V.

27th June, 1864.

PLATE VI.

27th June, 1864.

27th June.—The case is to be considered well, the foot is pretty well restored to symmetry, and the abnormal looseness of the anterior part remarked in the last paragraph has much disappeared. She can, with ease, raise herself on her toes of that foot, the other being off the ground. The shape of the foot is not quite beautiful, but is quite as good as that of most working women. (Plates v. and vi.)

Remarks.—It appears natural to suppose, that while the medio-tarsal joint remains abnormally loose, there is danger of return of the deformity; since it would seem to indicate, either that the weakened muscles have not yet regained sufficient power, while the opposers have been stretched to their proper length, or that the ligaments on one (the shortened side) have yielded to the power before the lengthened ones have duly contracted. I have never had courage to try this theory of return; but apply under such circumstances only just enough power to keep the joint in question properly rigid.

Case X.

T. Lording, aged 17, came to me at the Charing Cross Hospital, November 25, 1863, with severe valgus of the left foot.

The deformity began, says his mother, when he was between three and four year old. He did not walk till that time, but shuffled along on the ground, and when he did begin to walk, he did so very badly. It appears from the rather vague description of his earlier mode of progression, that this was a case of infantile paralysis. As at about the age of four years the deformity made its

appearance, and gradually increased, he was taken to the Orthopædic Hospital, where he was ordered a shoe with an iron affixed to the sole, and strapped to the upper part of the leg. This he wore for three and a half years, renewing it as the limb grew, and as he still got worse it was discontinued for about three years, and he remained without any treatment. At the end of that time he went again to the Orthopædic Hospital, falling under the care of another gentleman attached to the institution, who cut several tendons; in six months the knife was again used on different parts of the foot. It is impossible to ascertain exactly what were the tendons divided, but partly from description, partly from the situation of the scars, we may conclude that the peronei flexor, longus, digitorum, tibialis posticus, anticus and tendo Achilles were severed. The lad remained an out-patient at the institution till a week ago, when Mr. —— proposed to operate for the fifth time, but, as the patient says he got no benefit from the others he declined a repetition.

When I saw him (November 25, 1863) the foot was much deformed; there was a considerable retreating angle little more than 135° between anterior and posterior tarsus, both the heel and front of the foot sloping outwards from this point. On the inner side was an equal salient angle formed by the head of the astragalus, which is, however, in normal position, both the front of the foot and the heel having changed their relations to that bone, causing its posture to appear false, it is, however, found to lie naturally in the ankle-joint. Besides being abducted, the back and front of the foot were much rotated outward, the patient walking quite

on the inner side, chiefly on the salient angle, with great pain and difficulty. The muscles of the leg are wasted and flabby; the limb was a little less than an inch shorter than its fellow; the heel and anterior tarsus could with the hand be slightly abducted and rotated inwards on the astragalus, but the ankle-joint itself was very stiff. The patient was very lame, and complained of great pain on the inner side of the foot as well as over the outer part of the instep.

This case, evidently of paralytic origin, the muscles have already become fatty, they might of course have degenerated without the use of irons, &c. &c., but hardly to the extent here presented to us. I told him I could do him little or no good, but he begged for some attempt at alleviation, and treated him by applying the springs to represent the anterior and posterior tibials simply with the object of alleviating pain. It is not necessary to follow the details of this case, the photographs* show a greater improvement in the shape of the foot than I could have expected. He visited the hospital about every third week, saying he could not get on without the springs; the foot improved still further in form, and appeared somewhat stronger; he himself affirms that the foot is much better.

Sept. 11th, 1865.—This patient visited the hospital after five weeks' absence, and begged to have the appliances renewed, as he cannot walk without them.

* These photographs, owing to the great number, are not published.

CHAPTER IX.

TALIPES VARUS.

This deformity, which gives to the whole genus the name of club-foot, is the direct contrary of, and is, especially as a congenital malady, much more common than, valgus. It consists primarily and essentially of adduction and inward rotation of the front half of the foot to such an extent in the worst cases, that the sole looks backwards, even also a little upwards; the sufferer walking upon what ought to be the outer aspect of the instep. In some cases also, the heel is raised, and to this class the name of equino-varus is given.

It has already been mentioned, that the newly-born babe naturally holds the foot with its outer border lower than its inner, and in

some infants this tendency is so marked, that it is impossible to distinguish by mere sight a foot thus placed, but quite normal, from a slight degree of varus—indeed, even with the assistance of the hand, it is not possible in all cases, to decide absolutely, until certain manœuvres carefully watched have been practised—because in slight degrees of varus the foot may be placed in a normal position with very little force; and a child with a healthy foot often resists, to the extent of its small strength, any attempt to turn the limb out. The question to be solved, therefore, is not whether the surgeon can put the foot into a natural position, but whether the child, unassisted, can do so. In one of my cases, M. A., one foot was deformed, and it was very questionable whether the other was not also to a certain degree varous; but after careful experiment, tickling the sole with a feather, holding the feet towards a fire, application of cold, &c., I decided that the left foot was healthy, and the child, now learning to walk, has lost the peculiarity of attitude without any surgical assistance to the left foot.

When, however a child is born with a varus of the second, still more of the third degree, then there can be no doubt as to the existence of deformity. The malposture is as follows: the outer side of the foot faces directly downwards, and its outline instead of being a gentle curve, is very round, even angular, the greatest bend being below the outer ankle bone. The inner border of the foot facing directly upwards, forms with the bone of the shin, an acute angle, and the inner ankle is less prominent than is usual with children, the skin and subjacent tissues around that part are puckered and thrown into ridges and grooves; two of the latter are peculiar and constant, they form a rude letter T, the horizontal limb lying over the lower part of the inner ankle bone, the perpendicular one runs down to the sole corresponding to the medio-tarsal joint, and showing the great degree to which that articulation is bent inwards or adducted. The great toe is often very much extended and adducted, so that in the worst cases it lies very close to the shin bone.

The anatomical conditions of this deformity are extremely complex, scarcely any one bone of the whole twelve which form the solid part of the foot preserves its natural relationship to its neighbours. I will not enter into them here further than to observe that the scaphoid escapes quite to the inner side of the head of the astragalus, leaving its outer aspect bare; that bone itself is abducted (not as is generally believed, adducted), the prominent rounded head may be felt in all cases lying much further outward than any one not greatly accustomed to these deformities, would dream of looking for it. The posterior end of the os calcis is thrown outward (contrary to general belief), and sometimes to such an extent that its outer surface forms a new joint with the fibula.*

* The postures may be thus briefly described:—

Front of the Foot so violent inward rotation that the bones have described half an arc, their transverse axis having become perpendicular, such adduction that surfaces which normally look forwards now look inward.

Back of Foot. The longitudinal axes of calx and talus which normally agree are thrown out of correspondence; the former is adducted (*i. e.*, its anterior end is turned inward, its posterior outward) and rotated inwards. The latter (having undergone no rotation) is abducted, its head looking outwards. In equino-varus the calcareus is also raised.

Between the anterior end of this bone and the cuboid an angular gap may generally be felt, unless the infant be very fat, or unless in older persons the thickened skin conceal the interval. In after life it is frequently filled up.

The primary and efficient cause for all these misplacements is paralysis of the peronei muscles, and though such cause may at first sight appear insufficient to produce so great distortion, consideration will show that this is not the case. Be it remembered, that tendons of six muscles pass from the leg to the tarsus—that only five of these are inserted into the anterior tarsus, and in the cases under consideration three out of the five are paralyzed. Now the tendon of the peroneus longus runs from below the outer malleolus downward and a little forward for a short distance and then right across the sole to its inner side, in a mode which gives it the greatest possible mechanical advantage for outward rotation of the front half of the foot and very considerable power for abduction, and in this latter action it is greatly assisted

by the short peroneus, whose insertion in the projecting base of the fifth metatarsal bone far outside the line of all the tarsus, renders its action very forcible. The third muscle is also a valuable auxiliary to the rotatory action of the first named.

When then these muscles are paralysed the front of the foot falls entirely under the dominion of the two tibial muscles, the scaphoid and inner cuneiform must therefore be dragged towards the shin bone in a direction between the two tendons. Moreover, the powerful rotative action of the posterior muscle must, at the same time, cause the inner side of the foot to face upwards. Thus the two forces act peculiarly, the rotatory action alone would cause the sole to look directly inwards, but adduction to such extent is added that the point of the toes is turned inwards, and therefore the sole faces directly backwards. The peculiar position of the heel is also due to the same cause. We are to remember that the peroneus longus possesses besides the rotatory and abductor action, considerable power as an extensor of the foot, it is the

" extensor-abductor ; but the calf muscles are the extensor-adductor, that is, in raising the heel they also throw it outward.* When, therefore, the former muscle is paralysed all extending movements are produced by the sural muscles, and this action is therefore combined with outward movement of the heel. Moreover the posterior tibial tendon has become much shorter in the foot, the place therefore whence the slip for the os calcis is given off, is further back, and it acts necessarily in adducting the front part of the bone that is also in throwing the heel outwards (p. 109).

When a child, afflicted with varus, walks upon his lame and unassisted foot, the deformity will not decrease or disappear, as we have seen that the mere infantile peculiarity of posture will do. On the contrary, the weight falls so much on the outer side that it increases the abnormal position still further, and adds certain other conditions—such as enlargement of the outer part of the cuboid bone on which most stress falls—the develop-

* See the Experiments of M. Duchenne, of Boulogne ; Archives de Médicine, &c., 1864.

ment of a thick fluid pad or bursa over that spot, a longitudinal folding of the foot from doubling inward of the outer metatarsal bones, the destruction of the talo-scaphoid joint, and the production of a bony ridge separating the covered from the uncovered portion of the head of the astragalus.

We should always be able to give the patient, or the parents of a patient, some account of the probable prospects of cure, the duration of the treatment, and the absence of, or the amount of lameness that will be left behind. No degree of muscular contraction, and therefore no degree of distortion, negatives in the least an entire restoration of shape and function to the limb. The age of the deformity, and more particularly the state of the paralysed muscles, must be taken into account. If muscles be still entirely paralysed, and if such condition have continued for many months or years, we can, of course, give little hope of re-establishment of function; but I would strongly recommend the enunciation of no decidedly unfavourable opinion until the muscle be carefully subjected

to Faradization after the method of Duchenne, and as now generally used. So long as electric irritability remains in the muscle, so long may we entertain hopes of its functional restoration; when irritability is quite absent there is far less, still some hope of re-establishing the contractility. The paralysis, total or otherwise, influences in no way our ability of restoring the limb to shape, it only affects, though not so unfavourably as tenotomy, its subsequent power.

We must be guided in our judgment concerning perfect restoration of form by the amount of change in shape which the bones may have undergone. Even in a newly-born infant the disease may have begun so early in his development, that very much change is produced; and, of course, persons who have been walking on their crooked feet for years will have their bones much altered in form. The bones, whose condition above all others is important, are the astragalus and the scaphoid—particularly as to the shape of the head of the former bone and the condition of the joint between the two. The head of

the astragalus, which is almost left bare by the displacement of the navicular, should be felt beneath the skin, in shape rounded and prominent to a degree proportionate to the amount of displacement. Experience gives to the surgeon's fingers an instinct of this relation, which, if he find correct, may assure him that there is nothing in that part of the foot to counteract his efforts. But if, in spite of considerable deformity, he find the head of the bone dwindled and stunted, he will hardly hope to effect perfect restoration of the limb. Let him not, however, be precipitate; he must abduct and rotate outward the front of the foot, bringing it towards its natural position, as far as can be done without violence; if the scaphoid slide up, and, without either grating or jerking, approach its normal position, leaving no indentation behind it, the change of form in the astragalus will be of less consequence, and if the subject be young, will probably recover itself very considerably. Thus a small amount of atrophy in this portion of bone is not an absolute bar to perfect restoration; but the reduction of the head of

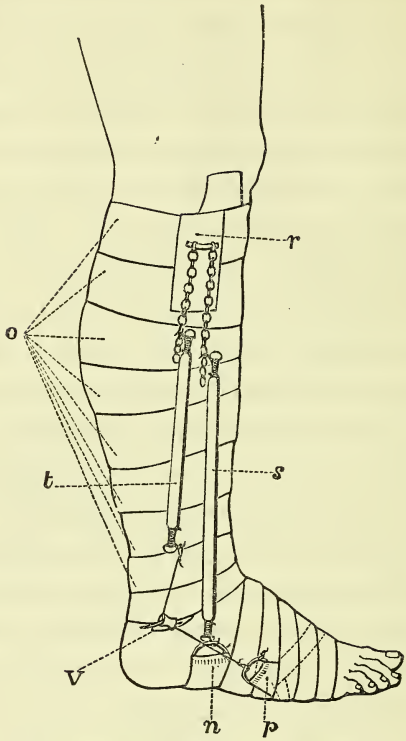
the astragalus to a mere tubercle is a very serious impediment. The alteration in this part of the foot may be taken as a very trustworthy index of the changes in the outer side. We have already pointed out that the adduction of the foot produces an angular gap between the os calcis and the cuboid, which has a tendency to become filled up by new material, preventing, like a wedge in a split tree, the return to normal posture. The amount of this filling up is always proportionate to the changes in the other bones above described.

The tendon-cutting treatment of varus is founded upon the system of restoring balance, between the paralysed muscles and their opponents, by paralysing the latter also. The tendons divided are nearly always four; the *tendo Achilles*, *tibialis anticus*, *tibialis posticus*, and *flexor longus digitorum*. If the artificial paralysis were a temporary evil, we could only say that its infliction is the best means of promoting fatty degeneration, but the table at p. 42 shows that except in the muscle of the first named tendon, the loss of power is lasting.

The action of the anterior tibial is permanently destroyed about once in three times, that of the others is always annihilated by the division of their tendons. This is by no means all the evil produced by such system, for after section the mutilated limb is put in a shoe, and rotated as a whole outward. This instrument acts, as far as its rotating power is concerned, entirely on the ankle-joint; no notice whatever being taken of the fact that the malposture is primarily and principally developed at the medio-tarsal articulation; thus, even if the front of the sole be brought to the ground, the heel becomes misplaced, or such distortion is only resisted by the mortoise-like grip of the ankle, and many are the cases in which that joint becomes seriously inflamed and injured. Moreover the foot being kept on an immovable basis, cannot have any play or action, and the muscles are left entirely inert during the whole period of treatment, while the paralysis, be it from fatty degeneration or other cause, is constantly getting worse.

The treatment I have adopted is founded

FIG. XIII.



THE TREATMENT OF VARUS, COMPLETE.

n, The upper end, with a wire loop, of a trapezoid piece of plaister, the continuation of which under the circular pieces is marked by dotted lines, and which adheres over a rather broader surface of the sole than the insertion of the peroneus longus; *p*, the end, with its wire loop of a piece of plaister, representing the insertion of the peroneus brevis; its continuation is marked with dotted lines, as being split so as to embrace the base of the metatarsal bone; *o*, circular strapping, covering but one piece of tin placed just behind the fibula, with its layer of plaister on either side; *r*, the remainder of the longitudinal strip of plaister brought down and adherent

upon the contrary idea of aiding and abetting the weakened muscles; but otherwise to leave the foot its full play, so as to give them the best chance of recovery from their paralysis. The method adopted in these cases is similar to that already explained. In this instance the two peronei are to be supplied, the third may occasionally, but very rarely, want assistance; under any circumstances, only one piece of metal with a loop at its upper part is needed; it is to be carefully moulded to fit the limb. It must carry at the lower part of its posterior edge an eyelet, which has been nipped in the eyelet pliers as for fixing it upon any substance, but is left barren, and this is to be fastened to the tin by twisting a wire through it, and through a little hole in the metal at the place named. The use of this arrangement will be seen immediately. Furthermore the slip of metal is to be included in slits in two pieces of plaister, after the manner

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to the outside of the circular ones; *s*, an india-rubber spring assisting the peroneus longus; *t*, an india-rubber spring assisting the peroneus brevis; at the lower part of it is an arrangement for changing the direction of the force; this is better seen in Fig. xiv. The end of the spring is covered with tubing, to guard the hooks.

explained (p. 92). The longitudinal piece of strapping is to adhere over the back edge of the fibula and the tin placed upon it.

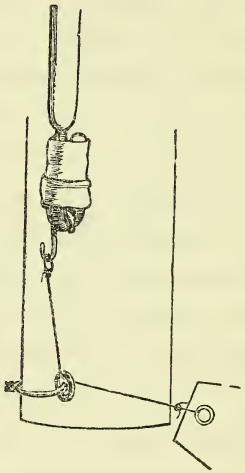
On the foot we have to supply two tendons; the long peroneal runs with very slight obliquity across the foot at the bases of the metatarsal bones; this direction must be imitated by a tolerably broad piece of plaister, which may be continued, so that its end turns a little round the inner edge of the foot. The other end, which is to be folded down (sticky sides together), is to lie below the outer malleolus. The tendon of the peroneus brevis runs along the outside of the foot, and is inserted into the fifth metatarsal bone, but this surface is too small to give sufficient adhesion to the plaister, I therefore split the strip a certain distance, letting one part adhere to the dorsum, the other to the sole of the foot; this has the same effect as an insertion merely on the outside. The end to carry the wire loop is not to be prolonged backward so that it approaches too near the fibula.

All these arrangements being completed,

the leg and foot are to be strapped as usual, taking care to leave uncovered the eyelet fastened to the tin. An india-rubber spring is simply to be stretched between the chain above and the strip of plaister representing the tendon of the peroneus longus; but it is more convenient to defer this until the arrangements for the other muscle have been made. The tendon of the short peroneus muscle makes a sudden angle below the fibula, playing round that bone like a pulley. This bend must be imitated, otherwise our supplementary force would not act in the direction of the muscular power. The eyelet, whose method of fastening to the tin has been described, is to be the pulley; a piece of catgut tied to the strip of plaister on the foot passes through it, and is attached by a loop to the india-rubber spring, by which means any desirable bend may be given. The arrangement, thus rapidly described, requires a little care in its adjustment; thus it is very necessary, when placing the plaister which represents the insertion on the foot, to bend the limb as near as it will go, without causing

pain, into the natural posture; also it will be necessary to tie the catgut very short; when this is difficult *in situ*, it may be fastened to a hook (a common dress hook), so as to give an

FIG. XIV.



Represents the lower end of the tin, upon which, by means of a twisted wire, a barren eyelet has been fastened. Through this eyelet a piece of catgut runs from the piece of strapping to the hook in the loop of the india-rubber spring. Upon this loop is a short bit of tubing, the lower end of which is turned up, displaying the hook, &c. When this part is turned down it completes the arrangement by covering the hook and preventing any possibility of slipping.

easier mode of tying, and then this can be passed into the wire loop in the strapping. The treatment commences most advanta-

geously, as a rule (especially in infants), by supplying only the peroneus longus; and when the inward rotation has been very much corrected, then the peroneus brevis may be added, and, in some cases, even used alone.

Cases of talipes varus differ so much in origin and in form, that it is quite impossible to specify a distinct limit of time, during which they can be cured; the period for milder cases is about three months; but it must be remembered, that during this whole interval the patient is not confined. On the contrary, if of an age to walk, he can do so from the beginning, much better with than without the appliance, and during the latter part of the time the lameness is scarcely, or not at all perceptible. I wish to insist strongly on this power of taking exercise, as being of very great importance, particularly if the paralysis have been severe, have lasted some time, or still continue; for it is evident that only by proper use can the muscles be prevented from becoming hopelessly atrophied and degenerated. It will take longer than three months to overcome the lameness and

deformity of the more strongly developed cases of varus by any proceeding hitherto in use, and however many be the tendons cut; and evidently therefore it is the more important to adopt a mode of treatment which shall not keep the limb confined.

In the case of infants not yet of an age to be put upon the feet, we have two points to consider—first, the posture; secondly, the debility of the peronei—hence, in these cases, we must have two intervals of treatment. The first is directed to posture, and I have found that even in very severe cases this can be rendered perfectly normal in from six to ten weeks. The strapping on the leg and foot, if carefully and skilfully applied, does not produce any irritation worthy of note. The force of the spring is very easily so regulated that no pain or restlessness ensues, if too great power be not used at first: moreover, it will be well, in the earlier period of treatment, to relax the spring at night. When the foot has regained its form the patient may be discharged, with the simple caution that at morning and evening toilet, and in convenient

moments during the day, the nurse or mother is to turn the foot well out with the hand; also, the parents must be forewarned that at the period when the child begins to try its feet at walking—*i.e.*, about the age of fifteen months—he must return to treatment, which simply consists in a repetition of the former plan; but the springs need only be stretched with slight force, for very little power will be sufficient to turn the foot well out. In this part of the treatment, particularly towards its end, the peroneus brevis is the muscle chiefly to be supplied. From three to six weeks will generally enable the infant to walk quite flat on the sole, and with the toe turned normally outward.

The time necessary for reducing the deformity in severe cases may, however, be very much shortened by the use of sudden extension under the influence of chloroform. This also is a procedure of my own adaptation to these diseases, and is one from which very great advantage may be drawn; but I would limit its employment to severe cases, and would caution surgeons against the use of violence,

since when once the muscular power is annihilated by the anæsthetic very little force is required to place the foot in a normal position.

The mode of proceeding is as follows: a gutta-percha or pasteboard splint is bandaged on the foot, and is allowed to harden or mould itself while the patient is taking chloroform; as soon as the influence of the drug is perceptible, the splint is removed, and the surgeon waits a few minutes until the anæsthesia is fully marked; he then grasps the posterior part of the foot with one hand, and the anterior with the other; having first turned the latter a little more inwards, he proceeds to straighten it, rotate it outward, and abduct it. This is not to be done too quickly, but with a certain freedom of movement. In a very short time the surgeon finds that he can cause the sole to face directly downwards, but that there remain flexion and adduction. A broad band along the sole, with a strongly marked edge internally, composed of the inner part of the plantar fascia and the abductor pollicis, checks further progress. The resistance is to

be overcome by holding the foot in one hand at the heel, in the other at the metatarsus, rendering this band quite tense, and then by giving a few quick, but not violent jerks in the direction of extension, causing it to yield. By this means the foot, unless advanced ossific changes be present, may be very quickly reduced to nearly a normal posture; but to fasten it to a splint in this position, would cause very severe, indeed unbearable pain; it must therefore be replaced in the gutta-percha or pasteboard splint, previously moulded to the limb. On the third day, the appliance being removed, the foot will as a rule be found in a state to employ the strapping, springs, &c.; but if too much force have been used, the parts will have been bruised, and another day or two must elapse. This is always a disadvantage, hence I am most careful to use as slight force as possible.

By the combination of these two methods, the deformity may be reduced in a remarkably short space of time; a month has in my hands sufficed to bring the foot into position; but all treatment cannot be immediately dis-

carded, since the muscular debility will probably still require support.

Certain cases of this deformity from paralysis come under care, when the patient is grown up: we can cure the malposture; but the paralysis being irremediable, lameness to a certain extent will persist, since some voluntary movements are impossible. Various shoes, irons, &c., have been used for the purpose of aiding progression; nothing hitherto invented approaches so nearly to the natural power, whose absence we would supply, as the caoutchouc springs in the direction and place of the absent muscles; and nothing so effectually aids and conceals the lameness.

It is a curious fact that varous patients who have been allowed to walk on the unassisted feet acquire a habit of turning in the thigh at the hip, so that the knees look very much inward. I believe this habit to arise thus: the turned-in feet of the cripple are very much in each other's way, particularly is the foot upon which he stands in the way of that which is being brought forward to make the next step; in this action, however, every

walker bends the knee. Now by turning the thigh in, he causes this very flexion of the knee to throw the lifted foot further out from the median line of the body, therefore further away from the weight-bearing foot. Whether, however, this causation be the true one or no, the habit itself is most difficult to overcome, often, indeed, more difficult than to restore the feet.

Case XI.

Mary A—, aged two months, was brought to me, 29th July, 1864, with varus, combined with slight equinus of the right foot. The distortion is severe, being of the third degree, and can be but very little benefited by traction with the hand. The retreating angle beneath the inner malleolus, with the T-shaped fold being very strongly marked. The salient angle on the outside of the foot was very prominent; the astragalus was very plainly perceptible; the skin of the whole leg from below the knee was colder than that of the other; the leg also was rather smaller, and very evidently more flabby than the left one. The weather at the above date was so dark, and the child so restless, that no photograph could be procured. I supplied the long peroneal muscle with but slight tension.

19th August.—The child has returned to observation once between this date and the last; the strapping being only removed on the foot, the limb was not in a state to photograph: on that occasion I increased a

little the force of the spring. At this date, as the leg was strapped, a photograph was procured; it shows much distortion, but the foot has a good deal improved in the last three weeks. (Plate vii.)

5th October.—The foot is now greatly better, the salient angle has very much disappeared; the head of the astragalus has assumed a more normal place, and has re-entered the socket of the scaphoid. The foot can now be placed in a perfectly normal position with the hand. The photograph (Plate viii.) shows slight outward rotation produced by the spring.

19th October.—All inward rotation, more than is usual with infants, has been overcome, and the rotated posture can with very slight traction be over-corrected with the hand. There remained, however, still some adduction. Peroneus longus discontinued, the peroneus brevis applied. The photograph shows how very nearly that spring overcame the tendency to adduction. (Plate ix.)

7th November.—The position of the foot is quite normal. All treatment discontinued. The following directions given. As the lady is resident in town, I am to see the child in February; in the meantime, the foot is occasionally during the day to be turned out with the hand; a bad position during sleep, if such should be assumed, is to be corrected. It is plainly understood that some further measures will be necessary when the child begins to walk.

17th February, 1865.—The foot has slightly returned to an inward rotation; this is usual, the child must begin to walk in normal posture before cure can be confirmed. Nothing done.

10th May.—Mrs. A— again brought her child, who now was beginning to get on her feet; the right foot was both adducted and rotated inwards: the slightest pressure with the hand, however, placed it in good position; indeed, the infantile tendency to these postures was almost as strong in the left as in the right foot. The peroneus longus was supplied.

31st May.—The child's foot has improved in strength, power, and position. (Plate x.)

24th June.—The photograph shows the foot restored, the sole flat to the ground. The cocking up the toe of the left foot is merely temporary posture. Attention is called to the fine development of the calf and muscles generally. (Plates xi. and xii.)

Case XII.

William S—, aged three months, came to me on the 22nd July, with congenital varus of the left foot: the distortion, as seen by the photograph (Plate xiii.) was severe, and was remarkably unyielding to manual pressure. The mother of this infant had four other children, and in this last pregnancy nothing unusual had occurred, nor had she observed any symptoms differing from those she suffered with her other children. I supplied the peroneus longus with but slight tension.

13th August.—The child was brought to my house, the mother saying that the plaisters have lately loosened so that she could not make sufficient pull on the foot; and there certainly is not as much improvement as might be expected. The photograph (Plate xiv.) shows the

posture at this date, and the next in order (Plate xv.) shows the position when the spring was supplied.

25th August.—The position of the foot has much improved, very little pressure with the hand places it in perfectly normal posture, without causing the slightest pain. In three weeks, or a month, the child will be discharged from care until it is of an age to walk. Plate xvi. gives an idea of the state of the foot, but a posture with much less inward rotation was frequently assumed, yet the position photographed scarcely differs from the "infantile posture." The case is not so much given as a record of cure as of the effect of a month's painless treatment. Plate xvii. shows the appliances affixed and the position induced.

Case XIII.

Sarah J. A—, aged 5, was brought to me at the Charing Cross Hospital, on the 14th of March, 1864, with a deformity of the right foot.

When a little more than two years old she was put to bed one evening quite well; next morning, when taken up, her right leg was found to be paralysed, otherwise she seemed quite well, although perhaps a little languid. A medical man in the neighbourhood saw her, and after some weeks power was found to be returning. Soon afterwards it was observed that the foot was twisted inwards, so that she walked on its outer side, and the toes turned in. As this deformity increased the child was taken to the Orthopædic Hospital, and there an instrument was ordered, which appears from description to have been a Scarpa's shoe. After a time, no improvement, says the mother, having taken place, another in-

PLATE XIII.

22nd July.

PLATE XIV.

13th August.

PLATE XV.

13th August.

PLATE XVI.

25th August.

PLATE XVII.

25th August.

To face page 152.

TALIPES VARUS.

strument was adopted, consisting of an ordinary lace-up boot, into the sole of which two irons, one on the outside, one on the inside, are fixed; these running upward are hinged at the ankle-joint to two other rods, which are continued to just below the knee, where they are fastened to the leg by straps; the instrument carries also a strap to go over the instep.

After twenty months of fortnightly visits to the hospital, and the child getting no better, the attendance ceased, though the boot was continued. A little before Michaelmas, 1863, the child was admitted an in-patient at Guy's, and she remained there nearly five months. The treatment consisted solely (according to statement) of her being put into another boot, which, instead of having rods on both sides, bore a single one on the outer side, which was hinged in the heel. This instrument did not appear productive of benefit, and the child coming out at the latter end of February, fell almost immediately under my care.

14th March.—The child came limping very much, and walking a good deal on the outside of the foot.

On examination, I found the case to be a complicated distortion. The photograph (Plate xviii.) gives the manner in which the child naturally walked and stood.

The right leg is much smaller in circumference from wasting of muscles, and measured, from the anterior tuberosity of the tibia to the inner malleolus, half an inch shorter than the left; the foot is rather more than three-quarters of an inch shorter than the sound one, from the excessive flexion below described. It is rotated inwards, a quarter of a turn, so that the sole looks almost directly inwards; the tarsus is strongly flexed

in the medio-tarsal joint; the first metatarsal bone is much flexed, so that the ball of the great toe is very prominent in the sole; the phalanges of the toe take in consequence two directions, the first phalanx is straightened, the second flexed.

The condition here is want of power in the peronei, especially in the long peroneus muscle. It is evident, however, that the paralysis did not last very long; indeed, there is at this date sufficient action in that muscle to resent to a certain degree the lengthening process inflicted on it by the inward rotation of the foot, but as it cannot overpower the opposing muscles, and place the foot in a normal posture, it expends its force on the first metatarsal bone, and bends it down in the manner above described.

At the same time it is to be observed, that there is something artificial in the deformity, that the boots she has worn, by preventing lateral movement of the foot, has also checked the recovery of the muscles, so that as soon as it is released from its irons the limb naturally becomes twisted as before. I applied a tin strip over the fibula, and with a spring, &c., supplied the peroneus longus muscle, after the manner already detailed. This, of course, turned the foot more out; at the same time, as I had been careful to cut the insertion plaister to avoid the base of the first metatarsal bone, it allowed the head of that bone to rise, and caused the inner side of the foot to be less arched.

14th April.—The child has returned to observation three times during the month elapsed; she suffered no pain, but is able to walk much better, and each time progressive improvement in the shape and length of the

PLATE XVIII.

14th March.

PLATE XIX.

5th May.

To face page 154.

Talipes Varus.

foot has been observed. She wears a low shoe, with a strap buttoning round the ankle, such as children of that age usually wear. The spring, however, while rotating the foot outwards, rather raises the heel, and having now caused such change in direction of the head of the inner metatarsal bone, as renders it advisable still further to rotate the foot, and to raise its whole anterior part, I now considered it desirable to add the peroneus tertius.

5th May.—A week ago, the foot could be brought by the hand so that the plane of the sole was at right angles to the leg. It would not remain in this position; but when the child was standing, the foot could be kept evenly on the ground by grasping the leg below the knee, and maintaining firm downward pressure.

To-day I dressed the child's limb, supplying the long and third peroneal muscles with such power as caused a reversal of the deformity. I caused her now to walk a little on the inner side of the foot.

It is unnecessary to follow further the details of this case. It only need be remarked that her limb increased in circumference regularly and gradually during the whole treatment. Her condition on the 5th of June, eighty days after I had seen her, seventy-eight after commencement of treatment (two days lost in obtaining the photograph) was as depicted in the photograph. (Plate xix.)

March, 1865.—Since the above date all treatment has been discarded, but the child is brought to me about every month, that I may see whether progress or relapse takes place. The child continues up to this time walking well, but weaker on the right than on the left foot.

The limb is, however, rapidly gaining strength, and no return of distortion can be perceived.

Case XIV.

Master B. M., aged $4\frac{1}{2}$, was brought to me by his uncle, Mr. H—, a practitioner in London, on 13th May, 1864.

He is not a strong child by any means, and came into my room with great difficulty. He lifted a foot, advanced it, and let it fall with a heavy thud on the floor, then stopped and panted before he could summon strength to lift the other foot. He had on him an instrument of iron extending on each leg from his waist to his boots, and weighing, with the boots, just over five pounds. Of this instrument, more in the sequel.

The deformity (double varus) was congenital. Since he was a fortnight old till four months ago he was under the care of one of the gentlemen attached to the Orthopædic Hospital.

The tendons Achilles, posterior tibial, and flexor longus digitorum, were divided on both feet; moreover, on the left foot the anterior tibial was cut, and a second operation for division of the tendo Achilles was performed—about six or eight months afterwards. An instrument, like the one he had on, was now ordered, and these renewed as the child grew out of them, he never being allowed to go without them.

There was a yellow haze on the day the boy came, and the photographer considers himself fortunate in securing even the photograph here affixed. (Plate xx.)

The legs and thighs are small, soft, and flabby; the left foot, as is evident from the plate, was the worse. On

PLATE XX.

13th May.

PLATE XXI.

7th June.

To face page 156.

pressing my fingers firmly behind either tibia, while alternately flexing and extending the foot, I could not detect the slightest movement of tendon. Neither foot could be brought, by pressure with the hand, into a normal posture. The posterior outer edge of the cuboid bone, and the anterior end of the os calcis, were very prominent. The feet, particularly the left, were much adducted and rotated inwards; in fact, it was a case of varus—simple, no doubt, at first—complicated by treatment.

The instrument which he wore consisted of ordinary highlows, to the outer side of whose soles an iron, jointed about the region of the ankle, knee, and hip, ascends to a metallic waistband, strapped by a buckle before and behind. On the inner side also of the sole, an iron is affixed, jointed at the ankle, and taking its bearing by a padded spring at the inner condyle of the femur. This instrument was very well manufactured, and as light, no doubt, as was compatible with sufficient strength, but it was a terrible infliction, and a grievous sight to see the poor little fellow dragging such a clog with him. Moreover, it must be remarked that great part of the success of such an instrument depends upon the boot fitting so accurately as to prevent the anterior tarsus rotating within it; thus the surgeon delegates what skill he might exercise to the shoemaker. But it may be questioned whether any shoemaker could make a boot so tight as to effect this object, and yet be bearable. In this case the foot did rotate, and there was a large wart or corn on the cuboid of each foot (largest on the left) on which the child walked. His father afterwards told me that he himself had remarked that the foot turned in the boot. Nay, so much was this the

case, that the thick sole of the boot itself has all the front part of it twisted a little inwards by the power of the foot, and the outer part only of the sole is worn.

I fixed the plaisters so as to supply the peroneus longus. The application altered the feet in form a good deal. He walked out with, of course, much limping, but was charmed at leaving the instrument behind him.

5th May.—The form of the feet much improved, and, what is of more importance in so early a stage, the legs were stronger. The sole came now so much better to the ground that I believed it advisable to supply both the peroneus longus and brevis.

7th June.—The photograph (Plate xxi.) shows the position at this date.

1st July.—The position of the feet, especially of the right, much improved, the posture, when springs are fixed, more nearly natural.

28th July.—The power in the legs and feet increasing greatly, the photograph (Plate xxii.) shows the improvement in posture.

There is only gradual improvement to report; the boy goes about now with very tolerable ease. About this time, I being away, the charge of the case was assumed by his uncle.

23rd October.—A photograph, as good as darkness, when long exposure was required, would permit, shows the position of the foot at that date. The legs are stronger, and the muscles have much more resilient and normal feeling. The springs on the right foot were discontinued, with the understanding that it might be necessary to renew them.

14th November.—The right foot remains in fair

PLATE XXII.

23rd October.

PLATE XXIII.

2nd December.

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TALIPES VARUS.

position while the boy is standing, but in walking he throws it a little inwards. I have therefore had a waistband made of leather, from the right side of which runs a strap, passing under the garter a little below the knee; from the end of this strap, to a little bit of leather fastened to the middle of the outer side of the sole of the boot, runs a spring; very slight tension is sufficient to correct this tendency to adduction. At this date, the spring representing the peroneus longus on the left foot was discontinued, and only the one supplying the peroneus brevis was used.

2nd December. — A photograph, showing the view behind. The peroneus brevis is now supplied. The boy is nearly well; the right foot is very good in form, and its action is fair; the shape of the left is not so good, but its cure is a mere matter of time. I do not, however, expect that the movements of the feet can ever be perfect, since the posterior tibial tendons have been destroyed. (Plate xxiii.)

July, 1865.—This boy, whom I saw during this month, has still improved, the feet being stronger and better in form.

The difference of effect between the prevalent treatment and my own is fairly marked in these two last cases. The former method had all the advantages of early age, and left, after several years, each case with much deformity and wearing irons. A few months of my treatment put the feet quite right in one case; nearly so in the other.

CHAPTER X.

TALIPES CAVUS AND TALIPES CALCANEUS.

I HAVE put these two forms of talipes under one heading, because they are allied, and also because the conditions exhibited, when both are considered in conjunction, throw much light upon the true nature of all pedal distortions.

These are both rare deformities; of the latter I have seen but one case, which I had neither an opportunity of treating nor of obtaining either cast or photograph. The latter deformity is not, as far as I know, mentioned by any English writer, although descriptions both by M. Bouvier, of Paris, and by M. Duchenne, of Boulogne, appear to refer to this form of distortion. I have seen two cases of this kind, natural ones, *i.e.*, not artifi-

cially produced, and have ventured to give the name of Talipes Cavus to the malady, because the expression appears to me to designate sufficiently the hollowed shape of the foot; the word arcuatus or perarcuatus might, however, suit equally well.

Talipes Cavus, by reference to the photographs (Plates xxiv. and xxv.), of this deformity, it will be seen that the foot is bent; that is, the tarsus is flexed upon itself, and, on closer examination, it will be perceived that this bend affects the posterior much more than the anterior part of the foot: in fact, the calcaneum has dropped, and the patient instead of walking on what ought to be the lower part of the heel, walks on its normally posterior aspect. The outline of the back of the leg, from the bend of the knee downwards, is very nearly straight. The normal outline of this part should present three curves; the upper one at the calf long, convex and full; the second one, concave; the greatest concavity being immediately behind the ankle bones; the third is the short abrupt prominence of the heel. Now, in these cases, all this undu-

lation is merged into one line, for all practical purposes quite straight, and especially is the prominence of the heel "conspicuous by its absence."

On directing our attention to the anterior part of the foot (that which lies in front of the medio-tarsal joint) we see that it is also bent down; this bend, however, is but slight, and on manipulating the foot the surgeon will find that even a small amount of pressure will restore it to its proper position in regard to the bones of the leg and astragalus. Indeed it is easily perceptible that this flexion of the anterior tarsus is secondary, although important, and produced in a sufficiently complicated manner. I will, therefore, beg the reader's patience for a time, that I may again refer to the physiological and pathological action of muscles.

The sural muscles are the most powerful extensors of the foot, but they are very much assisted in this action, chiefly by the peroneus longus, slightly by the posterior tibial. Now when the calf muscles fail to do their duty and become morbidly loose, the heel naturally

drops; but this does not necessitate raising of the front of the foot, if the other muscles at the back of the leg remain sound. On the contrary, these latter endeavouring to keep the foot normal by their extending force, must of necessity drag down the anterior tarsus. The peroneus longus, being the chief remaining extensor of the foot after defalcation of the muscles attached to the tendo Achilles, will, during its extending action, also tend to rotate the foot outwards; but this is prevented by the posterior tibial. Another function of the long peroneal is, however, unopposed, namely, that of depressing the head of the metatarsal bone, and in the photographs very forced depression of that part will be perceived; so much so that the extensor longus pollicis is put on the stretch, and lifts or extends the great toe very considerably. It will also be observed that there is some little outward rotation of the foot in the case of the girl; I was struck and somewhat puzzled to account for this until I was told that in walking there was pain under the ball of the great toe.

In both my cases of this deformity there

were the same symptoms, except that in the case of the young man this pain was absent. The walk was peculiar, the foot was lifted up and put down altogether, heel and toe at the same moment; it came heavily to the ground, and when the weight was to fall upon it the body was thrown to that side with a peculiar jerk. Walking was described as being very fatiguing. When my patients were made to walk about the room without stockings, it was observed that when the foot was lifted both heel and front portion doubled themselves more together than when the foot was on the ground, for the weight seemed to straighten out the bones.

The treatment in these cases must very much depend upon the age of the child and of the paralysis; if both be still young, I would prefer to begin simply by the means recommended in chapter vi., for the cure of infantile paralysis. Again, it may happen that as in one of the cases which I treated the muscle is already beginning to regain power; it will not, and cannot of itself, replace the foot; but it may require only very slight assistance for

but a short period. Of course some strong force must be applied in the position of the tendo Achilles, to lift the heel; and in the more severe cases power in front must also be used. Thus we shall have to supply three muscles: the sural group, the tibialis anticus, and the peroneus tertius. The two last can both be affixed to one piece of tin lying over the muscles between the two bones; there should be an additional wire loop on the outer side of the strip of metal, about two-thirds down the leg, for fixing the spring representing the last-named muscle. The insertions of these tendons must be represented in the manner already described.

The method of fixing a spring representing the muscles, attached to the tendo Achilles, must be now considered. The usual tin slip with the wire loop must be employed, it must be carefully bent to fit the leg, and must not extend low enough to interfere with the heel when the foot is fully extended; it must be secured in longitudinal folds, and slit pieces of plaister, as already described for other cases, *locis mutandis*. The insertion plaister must be

cut to the shape of a crescent, its middle adheres under the heel, the concavity looking backwards; the ends, to both of which wire loops are sewn, must terminate one on each side of the tendo Achilles.* To each of these loops a spring is to be fastened whose other ends are affixed to brass chains hanging from the wire loop in the upper part of the tin.

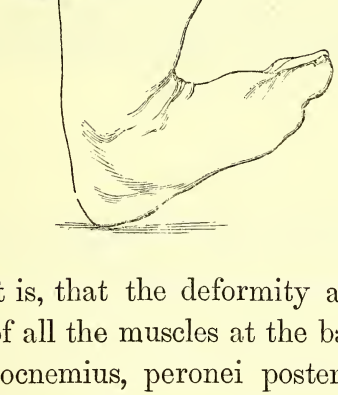
The leg and foot must be strapped evenly from below upwards as usual.

Talipes Calcaneus. This deformity is that which has been wrongfully described as resulting from paralysis of the sural muscles; we have just seen what distortion is in reality produced by that condition. The mistake originates in that deplorable—I had nearly said fatal—error of considering the foot as an inarticulate whole, which I have already censured; for it is only by such a view that paralysis of the calf muscles can for a moment be supposed to produce lifting of the anterior tarsus, which is under the sway of its five

* The beginner in this style of practice will do well to cut his patterns in paper, until he finds what shape will be required to serve his purposes.

special muscles thereto attached, and it is when the physiology of the foot is truly understood impossible to imagine that loss of power in a muscle attached to the extremity of the heel could possibly produce or permit such changes in the anterior tarsus as are here depicted.*

FIG. XV.



The fact is, that the deformity arises from paralysis of all the muscles at the back of the leg, gastrocnemius, peronei posterior tibial, the flexor longus digitorum and pollicis.

* This deformity is very rare. I have seen but one case. I had opportunity neither of treating it nor obtaining a photograph of the condition. I have therefore ventured to borrow the above illustration from Mr. Brodhurst's work on club-foot. The morbid form is very well represented.

In these cases again, if the paralysis be of recent date, I should at first simply treat the paralysis according to the method described in chapter vi. After a time, if it became necessary, a strip of tin broader than that used for pes cavus should be attached over the calf, and in addition to these, for the gastrocnemius strings, for the peroneus longus and posterior tibial can be readily affixed to it. As I, however, have never treated such a case, I can only indicate the form of management which, judging from analogy to my other cases, would be probably successful.

The youth whose foot is photographed (Plate xxv.) could not, for family reasons, remain under treatment.

Case XV.

Pes Cavus.—M. L., aged 6, was brought to me by her mother, October 18, 1864, for a deformity represented in plate xxiv., fully described as pes cavus (p. 161). It will be unnecessary to describe it, therefore, here.

The child had been for years under the care of Mr. ——, Orthopædist, and had used a quantity of instruments founded on the Scarpa's shoe, without benefit. The last time this gentleman was consulted he wished to cut the tendo Achilles and one of the tendons in the

PLATE XXIV.

PLATE XXV.

To face page 168.

TALIPES CAVUS.

front of the foot (probably the anterior tibial), but this was objected to.

I supplied the anterior tibial, the peroneus tertius, in front, and the gastrocnemius behind. The application was troublesome, but had great effect in improving the posture of the foot.

24th October.—There is much improvement in the shape of the foot. I have re-adapted the plaister on the foot once since the last report. This day the whole was renewed, with the exception of the anterior tibial spring, which was discontinued. At the same time, an addition of a leather inside the heel of the boot was ordered.

7th November.—The foot is very much improved, the heel in a more normal posture, and the arch less exaggerated. I re-applied the plaister, &c., for the peroneus tertius only. The heel appears to be lifting readily of itself. The gastrocnemius answered well to the electric stimulus, and a battery is to be used every night and morning.

3rd December.—Improvement has been more rapid than I could have expected. The foot is now in very fair position, but there is still some difficulty in lifting the heel from the ground.

10th December.—Took leave of the patient, the foot was perfectly restored; it was photographed, but being normal, I do not publish the plate.

CHAPTER XI.

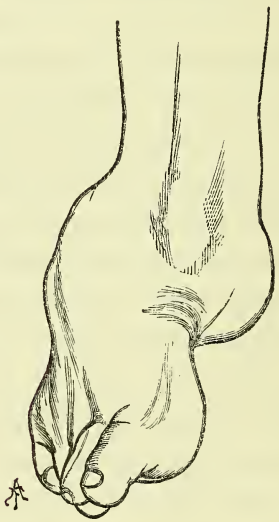
TALIPES EQUINUS.

Talipes Equinus has been regarded as a very simple deformity, and ascribed to contraction of the sural muscles, for which it has been assumed that division of the tendo Achilles was the simple and efficient cure. We have seen that the reunion of this tendon was almost a certainty, but the division nevertheless permanently weakens the muscle; nor is such procedure as a rule an efficient cure for the disease: partly, because contraction is sure to recur; chiefly, because the calf muscles are not the seat of the disease. If they be retracted at all, this condition is only secondary, and has nothing to do with the malposture nor with its cause.

It requires only a careful examination of a limb, thus distorted, to convince any unprejudiced surgeon of the truth of the above statement. Talipes equinus is rarely congenital, it arises chiefly in infants under five years of age; but may commence in much later life; for instance, I have a lad aged fourteen now under my care, in whom the distortion first made its appearance less than a year ago. We have, therefore, frequent opportunities of examining such a deformity, while still as it were nascent, at least quite recent, and of ascertained date. If the muscles, attached to the tendo Achilles, were the offenders in this deformity, the foot ought to be extended as a whole; itself perfect in shape, it should have only a malposture at the ankle-joint. This, however, is by no means the case; for one of the essential characteristics of equinal deformity is the great dorsal prominence of the head of the astragalus, which is left uncovered by the scaphoid, through excessive flexion of the anterior on the posterior part of the foot; thus again, we find that it is the medio-tarsal

joint which is chiefly affected. The posterior half of the foot is occasionally drawn up a good deal (secondarily), in general only to a slight degree, sometimes hardly at all; but in all instances, and whatever may be the position of the heel, the prominence of the head of the astragalus is always strongly

FIG. XVI.



TALIPES EQUINUS.

The straight position of the heel, and the malposition at the front of the foot, and the projection of the head of the astragalus are carefully copied from the model.

marked. I must caution my readers against mistaking an apparent disappearance of the heel behind the tibia for a phenomenon of extension, that is, for one of the essential causes of the deformity; because in reality this condition is not one of position, but of form; it is a secondary consequence of the disease. When the deformity begins in early life, so that the patient has always walked on the front of the foot, never used the posterior part, and never put the heel to the ground, this latter, deprived of its ordinary stimulus to development, remains small and rudimentary, and is generally mistaken for a bone, so greatly extended as to lie almost concealed behind the malleoli. When the malposition commences later, at four, eight or twelve years of age, at which periods the foot has already become somewhat formed, so that the development of the bones will not be instantly checked by any alterations in the conditions of their use, the os calcis never becomes thus apparently hidden; but remains prominent, and very much less extended than is generally supposed to be the case. If the

reader will take the pains to examine cases or casts, and to look at dissected preparations, he will be convinced that this deformity consists chiefly, or almost entirely, in the flexion of the anterior on the posterior half of the tarsus, as above explained. If he will also look at the illustrations in orthopædic books, I believe he will wonder that the doctrine of extension from the heel has ever been taught.

The cause of talipes equinus is, like that of the other pedal deformities, paralysis, the affected muscles being those supplied by the anterior tibial nerve, generally all of them, sometimes only two; never, I believe, as taught by tenotomists, the anterior tibial muscle only. The whole set thus supplied are extensors;* but those intended to move the tarsus only are the tibialis anticus and the peroneus tertius; their antagonists are the posterior tibial and the long peroneal, which, when the anterior muscles have lost their power, bend down by their simultaneous

* The nomenclature of muscular action about the foot is unfortunate, the direction of extension of the tarsus being the same as flexion of the ankle, thus the muscles named in the text bend the ankle and extend the tarsus.

ascendancy the front of the foot. This action produces that inflexion of a little more than a right angle at the medio-tarsal joint, which is the essence of talipes equinus.

The tenotomist's treatment of this deformity is above all things to cut through the tendo Achilles, then to put the foot in a shoe with a rigid sole (as depicted at p. 60), provided with a screw that acts primarily, in fact entirely, on the ankle-joint. The iron sole of this instrument gives a certain support to the front of the foot, and does not permit its further contraction, but the screw cannot in any way increase the angle between that part and the posterior portion of the limb. In fact, the whole influence upon the real causes of the deformity might be carried out just as well by a splint and foot-board, even without division of the tendo Achilles, which is not the true antagonist of the paralysed muscles.

Let us then examine what is really effected by this treatment—to do so fairly, we must begin from the beginning. The heel does not come to the ground because the tarsus is so much bent down at the medio-tarsal joint that

the ball of the foot lies below the level of the calcaneum. Now, the rational object of treatment would be to straighten out this abnormal bend; but there certainly is another way of getting the heel to the ground, namely, by causing it also to bend abnormally downward, till it gets itself on the same level as the anterior part of the foot, and this may be effected with more or less ease by cutting the tendo Achilles, placing the foot on a shoe, and then screwing the heel down. By the pressure of the shoe, the ankle-joint becomes flexed, and the scar of the tendon lengthened out, the heel therefore depressed; the anterior foot is of course straighter in reference to the leg, but not by any means so in reference to the rest of the tarsus. This part, therefore, retains its abnormal bend, and to the deformity all possible has been done to add depression of the heel; but so difficult is it to stretch, permanently, the tendinous scar, that the knife is frequently used three, four, ay, even nine times. If, after all, the treatment has effected its object of bringing the heel to the ground, it has done so, not by

straightening out the abnormal bend in the foot, but by adding another thereto; the foot left behind is not a normally shaped one, but is an artificial *Pes Cavus*. (Chapter x.) I refer here to what has been said at page 57, and to any patient having at first a moderate degree of equinus treated by this method, and to the photograph (Plate i.) of L. A. Not because that plate represents a true *pes cavus*, for the tenotomy treatment was by no means successful in bringing the heel to the ground; but the position and commencement of hollow foot has nevertheless been attained.

My treatment for this deformity is on the same principle as for others, namely, to act primarily on the part primarily distorted—the front of the foot. A single piece of tin placed upon a longitudinal strip of plaister in front, and to the outer side of the tibia, suffices, if it be rather broader than that used in flat foot, to furnish the origin of both tibialis anticus and peroneus tertius. The former is supplied by the wire loop at the top, as already described; the latter should be supplied by another loop

on the outer side, half-way down the metal, and running longitudinally. In slighter cases, or in those which have already been partly conquered, even one spring of india-rubber will suffice; but generally it is desirable to use two, adjusting their strength in the proportions which appear best to correct the malposture; for in some cases the front of the foot turns a little in, in others a little out, and must be treated accordingly.

The insertion of the tibialis anticus has been described; that of the peroneus tertius is into the base of the metatarsal bone of the little toe, but in imitating this in plaister it is better to let the strip run under the sole. There is some difficulty in arranging these pieces so as to bind them down with strapping, that shall go all round and cover the whole foot, and yet not include the wire loops in the plaister; but if the ends of the plaister be left short, and if the strips going round the foot be notched, where they cross the edges of the first-named pieces, if advantage be taken of the bends in the metatarsus, in fact, if a little ingenuity be used, the difficulty

will be soon overcome. It will be well to mention that the patient had better wear an ordinary low shoe; but if from any circumstances, it be desired to use a boot, it will be more easily put on, if a piece of catgut be interposed between the spring and the plaister, so as to give more room.

The treatment by this means of talipes equinus is very successful, insomuch that patients express themselves on the first application as much more comfortable; they walk, too, with far greater ease, the shape of the foot rapidly alters, and it is generally reduced to its proper position in from six weeks to a longer interval. But the application must not be left off until there be some considerable improvement in the paralytic condition; which is to be hastened by encouraging the patient to walk, and to take all possible exercise.

I must repeat, that one of the great objections to houghing a patient is the necessity of keeping him at rest for a month or six weeks after the operation, a procedure which offers to the paralysis every facility for getting

worse. The heel is very seldom drawn up sufficiently to warrant tenotomy; most of the cases, in which there appears to be excessive extension at the ankle-joint, arising rather from want of development than contraction. Still there may occasionally, but very rarely, occur some cases in which, on account of a certain difficulty, and for the sake of an immediate advantage, it may be desirable to cut the tendo Achilles. The difficulty is this: the axis of the anterior tarsus may so nearly correspond with that of the leg, that the plaister of insertion cannot be made to remain in its place. The advantage which tenotomy might then offer, is that the whole posture of the foot can be at once so changed at the ankle-joint as to enable the plaister to adhere without being dragged back. Nevertheless, the change of position on cutting this tendon is much less than might at first sight be expected, and section therefore yields less advantage than sudden extension of the tarsus, while the patient is under the influence of chloroform.

To do this the surgeon is fully to straighten out the anterior tarsus, and when that has been

effected, he must cease exerting any power on that portion of the limb; but may grasp the waist of the foot immediately in front of the tibia with one hand, and the heel firmly with the other. A great deal of flexion of the ankle, that is, extension of the gastrocnemius, can thus be obtained by vigorous and yet cautious proceedings. Of course the foot must be kept in the old posture for three or four days before springs can be applied.

Case XVI.

James Burt, aged 14, a weakly-looking lad, came to me at the Charing Cross Hospital, September 26, 1862, with talipes equinus of the left foot, arising from complete paralysis of the muscles anterior to the tibia.

The front of the foot was drawn down, so that the sole was doubled in two at about a right angle; the heel being hardly elevated; the projection of the head of the astragalus was very strongly marked, the scaphoid having left it almost bare. The heel was hardly at all raised, and projected normally. The leg was very much shrunken, and all the muscles on the front of the leg were weakened. The condition of the deformity was somewhat singular; for when the foot was lifted from the ground the front half fell into a complete equinus; but when the weight fell on it the deformity diminished, and the heel approached the ground more nearly than

would be expected. On lifting the foot, the front of it fell again, and the deformity re-established itself.

The condition of the muscles and their degree of sensitiveness to the magneto-electric machine was tried; the response of those at the back of the tibia and of the fibula was rather feeble, but quite distinct. The action of some in front of the leg was doubtful. It appeared that the extensor longus digitorum was capable of slight action, also the extensor of the great toe, but the anterior tibial did not contract at all.

I applied the apparatus and the spring after the method described at p. 177. A slight degree of force exerted by the india-rubber was sufficient to put the foot into very fair position, and it appeared to me best to use but a small amount of power at first. He walked much better with the apparatus on.

24th October.—The bend in the sole had diminished, and the tension of parts in that place, which prevented the foot being straightened, was considerably less; re-applied the apparatus, putting on a shorter spring.

22nd December.—There have been two visits since last report, and each time the shape of the limb has shown improvement. Made him walk without the apparatus; it was evident that he had acquired more power of raising the anterior half of the foot. Again tried the magneto-electric spark. The muscles generally responded better to the stimulus; the anterior tibial had now certainly regained some power, for, when the current was directed through it, its tendon stood out in relief. Re-applied the apparatus with a still shorter spring.

14th January.—The alteration in the shape of the

foot was quite remarkable; it was very nearly straight, and the power in the anterior tibial had greatly increased. In fact, there was little lameness remaining, except that when the spring was removed the front part of the foot came to the ground a little too soon.

13th February.—The boy had not returned between this and the former date. The foot was quite restored, and even when the spring was removed he walked without limping; however, to quite guard against any relapse, the spring was re-applied.

Case XVII.

Ellen S—, aged 3½ years, was brought to me February 1864, with well marked equinus of the right foot. The child was born healthy; when about ten months old it was discovered one morning that she seemed awkward in one leg, and at last she did not move it. The chief medical man in the neighbouring town was sent for, and diagnosed a paralysis. She was well and judiciously treated, and after a time a certain amount of power gradually returned. She learned about a year ago to walk, but never put the heel to the ground. The foot was always extended on the leg, and anxiety increasing, she was at the above date brought to me.

The right foot is markedly equinous; the sole is very much bent,—the head of the astragalus and anterior end of the calcaneum make a prominence on the dorsum; the toes are spread out, the foot being broader than the other across the heads of the metatarsal bones. Any attempt to alter this position with the hand throws into strong tension and considerable relief the tendo Achilles. The calf is small and high up in the leg.

6th February.—Having explained to the parents the desirability of sudden extension under chloroform, I this day operated. The patient having been put fully under the influence of the drug, I first tried to flex the ankle-joint; and, though to a certain extent successful, could not bring the heel as low as I wished; I therefore passed a loop of webbing stirrup-like, under the sole, behind the medio-tarsal joint, twisted the ends of the webbing round my right hand in front of the tibia, with my left hand grasped the heel, and at the same time prevented the webbing from slipping, while Mr. H—, who gave chloroform, and otherwise assisted me, held the leg firmly below the knee with that joint bent. I made strong traction upward on the webbing and downward on the heel; after a time there was a little yielding. One or two jerks and then again steady traction, and repeated jerks very soon had the desired effect; the latter result of the force was to make the muscle yield with a sensible crepitation; the knee was then straightened, traction being still maintained. I then took away the loop and clasping my fingers together under the sole and placing my thumbs on the prominent bones at the back of the tarsus; I in adducting the hands found but little resistance in straightening the tarsus. Of course, as soon as force was withdrawn the foot returned somewhat; but not by any means altogether to its original position; yet when pressure so slight that it could be made with one finger under the ball of the toes, was applied, the shape and position of the foot was not very far from the normal.

The leg was bandaged upon a previously prepared gutta-percha splint.

8th February.—The splint was taken off; passive movement appeared to cause some pain; the child, at all events, screamed violently. But much of this was due to fear, for managing to interest the child, and calm her, I found that considerable movement could be practised without causing any sign of pain.

10th February.—Supplied the anterior tibial and peroneus tertius by means of a single tin in front of the bones, and a single piece of plaister for their insertion, passing under the sole of the foot. But little tension was used. The springs were to be kept on all night; but if this caused restlessness, they were to be loosened on the chain; she was allowed to get up and walk.

February 29th.—The plaisters on the foot had been re-applied once since the last date. The whole appliance (leg and foot) was this day re-arranged in a similar manner. The foot has a little tendency outward; this is prevented by making the spring representing the anterior tibial proportionally stronger than that which represents the peroneus tertius. For a few nights after the first application of the springs, the child slept less well than usual; but afterwards this symptom passed away, and she has worn with perfect comfort the same springs night and day since the 15th. The foot is much better in shape; there is still too much arch, however, and the heel does not, in walking, come to the ground, by the thickness of two of the new penny pieces.

19th March.—There has been nothing further to report than gradual progress. The leg is now better developed, the calf coming lower on the limb; the heel just touches the ground; but apparently no weight

comes on it. The arch of the foot is but very little higher than the other, I re-applied the plaister, and ordered a boot with no heel, in fact, thicker in front than behind.

2nd May.—Since the last report the child has been away; the heel now comes to the ground very fairly; there is still, however, a little awkwardness of gait, owing not to any defect in the shape of the foot, but to a little shortness and weakness of the whole limb; the muscles, however, are better developed, and the child can stand and hop on the right foot nearly as well as on the left. I still advised a heelless boot with a pad about a quarter of an inch thick inside the front.

17th October.—In reply to inquiries by letter, I received the following: "Nelly is very well, and is at this moment running about with her brothers and sisters, as well, I think, as any of them—she runs indeed rather better than she walks; but I think that the very little lameness that she has is getting better, and she wants to have her boots made alike."

CHAPTER XII.

DISTORTED TOES.

It is a habit with many young ladies, and also with a great many young gentlemen, to wear shoes that are too narrow in the tread, and far too pointed; among the evils resulting from such habit is a peculiar distortion of certain toes. The great toe is pressed outward, and no longer lies in a line with the inner border of the foot, but stands away, so that a projecting angle is formed at its joint; and upon this angle comes much pressure, causing, after a time, a bunion. Moreover, the end of the great toe is made to lie in contact with the third, to occupy the place that ought to belong to the second toe, which is squeezed away into some abnormal place and

form. The most usual position is as follows: its first phalanx is pressed upward, lies above the level of the other toes, the joint between that and the second phalanx being very much bent, its end passing down through the triangular space left between the great and third toe, so that the nail phalanx comes with its end on the ground. The bent joint lies above the level of the other toes, and upon it a very painful corn is soon formed; the point of the toe, too, pressing upon the ground, becomes the seat of another tender excrescence, and these two causes will render the patient very lame, and often quite unable to walk.

It is unnecessary to enter into very minute details of anatomy, healthy and morbid, for a very little knowledge will show that to cut the tendon either of a toe or a finger is simply to lame that finger or toe for ever.* In the treatment of these maladies, I have adopted the plans to be explained. If the case be not severe, nor of long standing, the

* The curious or sceptical reader will do well to consult "Malgaigne's Leçons d'Orthopédie," chap. i.

following appliances will suffice:—A long strip of plaister, not quite so broad as the first phalanx of the toe to be treated is long, must be applied with its middle on the back of that phalanx. The rest of the plaister (the parts on each side of the middle) passes between the other toes round the phalanx in question; they will meet and cross each other under the ball of the foot, and will run respectively to the inner and outer borders of the foot, and still further continued, will again meet and cross at the instep; going still onward, they come together again at the back of the heel, thence they run round the ankle and meet in front of that joint. If the foot be very small, so that a plaister only as broad as the length of the phalanx be thought too narrow, then the strip may be cut broader, and at the part where it goes round the toe, a portion of that breadth may be cut out. This plaister, properly applied and sufficiently tight, will keep down the first phalanx.

We now pass to the means of keeping up the other phalanges. Take another piece of plaister, about half or a third of an inch wide,

and six inches or more long, split it lengthwise to within two inches of one end, place the fork of the slit just beyond the bent joint of the toe, and wind the narrow portions round the end phalanges until the whole is firmly secured. The two inches of unsplit plaister are to be doubled, sticky sides together, and sewn round a strong piece of elastic cord,* and its ends are to be secured to a piece of tape sewn to the two crossings of our first described strip of plaister at the instep, and at the ankle. Tension sufficient, but not excessive, must be used.

This method of fixing the plaisters, &c., is to be the groundwork; but it is not to be like the Medean laws, unalterable, for different people's feet are tender in different parts. The mode of fixing the india-rubber may also be varied, as we want more or less pressure.

This treatment, however, will not do alone when the deformity is severe and of long standing. In such cases it is advisable to straighten the toe under chloroform, and I have even found it necessary to use considerable power to

* What ladies call "elastic," procurable at haberdashers'.

effect this object; the parts yielding to pressure convey a sensation to the hand like rubbing together two surfaces of crape or thick silk. After the little operation, the toe must be left alone for a day or two, and then the appliance as above described adopted. The patient must of course go more reasonably shod for the future.

This condition of foot produces great pain and discomfort; but it is a malady in itself so trifling, that I do not intend to give cases. I have treated six without chloroform, eight with. I have never had a failure, and never met with any ill effects produced by the treatment.

CHAPTER XIII.

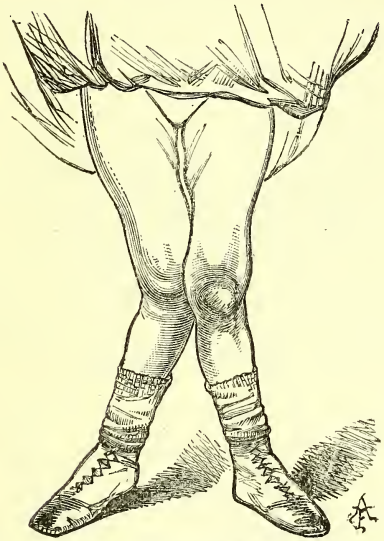
DEFORMITIES OF THE LEG.

Knock-knee or Genu Valgum.

We must now consider a set of deformities, which affect the legs, and for whose cure I have realized a new method, founded, I believe, upon better principles, and much more effective than any hitherto in use. We will first speak of knock-knee. It is not my intention to enter so minutely into the anatomy and natural history of this condition as into that of club-foot, but I must point out that there are two sorts of knock-knee, which seem to me to arise from different constitutional and local causes. The one always begins in early infancy, as soon or nearly as soon as the weight of the body falls upon the

limb, and is combined with, and in all probability is caused by rickets. In such cases

FIG. XVII.



THE CURVED KNOCK-KNEE, FROM A CHILD AGED SIX.

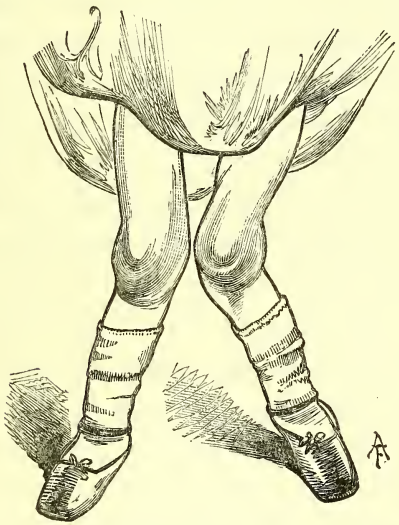
the shafts of the bones themselves are bent in a peculiar manner, whose type never changes, although nature permits in this, as in all organic changes, slight variations within certain limits. The femur receives two bends, the upper half curves, so that the convexity looks forward and outward; the

lower half in the contrary direction, its convexity looking inward and backward; at the same time it is twisted, so that what is normally its anterior face, and that which should be the front of the knee-joint, looks abnormally outward. The tibia follows curves which are the exact inverse of those in the femur, the upper convexity looks backwards and inwards, the lower one forwards and outwards. Thus, the limb as a whole receives three curves, whose plan for both legs may be given as outward above and below, inward in the middle. In these cases the foot is valgous, that is, the toes look outward, and the patient walks on the inside of the foot. (Plate xxvi.)

To express in a few words the difference in form between the first and the second sort of knock-knee, it might be said that one is a curved limb, and the other an angular limb. The second sort does not depend like the former upon curvature in the shafts of the bones; but upon some change near the knee-joint, which causes the tibia to slope abnormally outwards; but since the point of support

must be as near under the centre of gravity as possible, this outward inclination of the lower part of the limb is compensated by an inward obliquity of the thigh. It has been

FIG. XVIII.



THE ANGULAR KNOCK-KNEE, FROM A BOY AGED FIVE.

Much more marked in the left than in the right limb.

frequently asserted that yielding of the internal lateral ligament causes this condition, by allowing the knee-joint to gape at its inner side. I cannot find the slightest

grounds for such a statement; nor do I believe it possible for a joint to exist even for a few hours under the supposed conditions. The actual locality of the morbid change appears to me to reside in the lower epiphysis of the femur, and upper one of the tibia. Thus the angular bend is not a single one, situated at the articulation; but, as is seen on careful examination, the knee-joint itself and the bones a little over and under that point are in normal relationship; thus the bend is a double one, situated above and below the knee at the situation of the epiphyses. The foot in these cases is generally slightly varous, that is to say, twisted inwards, so that the sole rests pretty fairly on the ground, in spite of the misplacement of the tibia. This latter sort of deformity sometimes, indeed, not very infrequently, occurs in only one leg; the former is seldom, as far as my experience goes, otherwise than double.

In both cases the patient, when standing upright, places the knees close together, so as to allow them to support each other, and when in this position the limb can be kept

straighter than if one foot be advanced in front of the other, so that the knees lose their mutual aid. In walking, these patients have a peculiar uncertain, waddling gait, partly produced by the distance of the feet from each other, partly by the weakness of the limb, partly by the necessity of making each knee, as it is advanced, pass from behind, round the inner side, to the front of the other.

Bow-leg or Genu Extrorsum.

It appears quite impossible to say why some children's leg-bones, being too soft, should curve inwards, others should curve outwards; nor do I consider, that in a work of this kind, the question is of great importance. But it may be pointed out, that infants with well developed rickets have not bow-legs, and although there is a soft-boned condition in these latter cases, and therefore a general appearance somewhat simulating rickets, yet the condition is not true rachitis. Children thus affected have a very odd mode of progression; the feet, but more especially

the knees, are so wide apart, that the body has to be thrown from side to side at each step, and thus is acquired a quaint roll in the walk, that is very ugly, although at the same time rather comical.

An uglier deformity even than a pair of knock-knees, or of bow-legs, is the possession of a bow-leg on one side, and a valgous knee on the other (Plate xxviii.) The condition is not very uncommon; it always produces a lateral curvature of the spine, but if the legs can be cured, the condition of the spine will, as a rule, get well of itself.

A few children recover from these complaints as they grow up; but by far the larger number are never otherwise than cripples. Great importance is to be attached to early treatment, for as the bones harden so will the difficulty of cure be increased.

Treatment of Deformities of the Leg.

The usual method of treating these deformities, is to bind a padded wooden splint on the outside of the leg with webbing straps.

That bond, which corresponds to the part of the limb most removed from the straight line, is pulled most tightly, in the hope of dragging that point nearer to the rectilinear splint. There is something in the extreme artlessness of this contrivance, which is almost touching, which would, indeed, be amusing were it not for the evils produced by its application. The Procrustean couch for each limb, into the shape of which the child's legs are to be rigidly dragged by the brute force of a buckle, has the additional inconvenience of keeping the knee-joint always stiff; thus the children afflicted with such treatment are obliged to walk in a particularly unnatural and fatiguing manner; being only able to lift the foot from the ground, by throwing each limb round the other, and the body, therefore, much over to the side at every step. They thus frequently fall very severely, so much so, that a patient thus treated, and who subsequently came under my care, had twice broken a limb, once an arm, and once a thigh, while thus crippled by her splints.

The method which I employ does not confine the knee-joint, and substitutes an active resilient power for the stiff wood and inelastic strap. It is founded upon the idea of bending a straight piece of elastic steel (spring temper) to the same degree as the abnormal curve of the limb, fastening it, thus bent, to the leg, and then removing the retaining power, so that the tendency of the spring to become straight may exert a certain, and a plastic force, upon the abnormal curve of the limb. If, instead of employing a single splint, we use two,—one for the thigh, one for the leg—and pivot these together at a place which shall correspond with the knee, we procure a spring action along the whole length of the limb, and allow that important joint perfectly free flexion. Of course, for the effective use of this apparatus, it is necessary that it should sit quite close to the limb, without the chance of slipping; and I am willing to confess, that I met with many difficulties in devising the best method of applying the above principle; but, having overcome these, I find the plan of treatment

very efficacious. The spring splint must be made of steel plate about 9 gauge, well tempered, and from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches broad, according to the case. The hinge pivot must be quite flattened on one side : distant from it about half or three-quarters of an inch, a hole is to be bored through both thicknesses of the spring, while the two portions are in a straight line with each other. This hole is intended to receive a little flat-headed pin, which will prevent the hinge yielding to the force we must employ by means of the clamp to be described, for giving the proper curve to the splint.

The clamp is simply a square iron rod, carrying at one end a projecting portion, which at its extremity comes to a blunt edge ; just below this edge and parallel to it is a little groove. A similar projection slides up and down the staff, but, by means of a binding screw, can be kept fixed at any point upon it. When the spring splint is placed with its two ends in the notches of these projections, the movable stud is approximated to the other, until the spring is bent suffi-

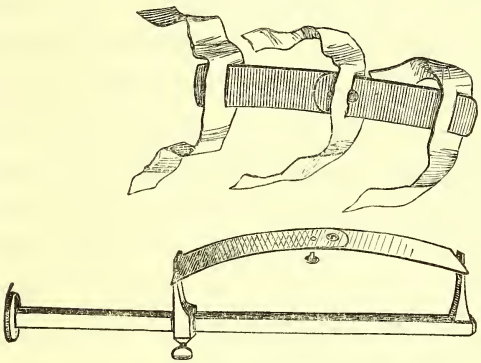
ciently, and then the binding screw is made to act.

Now, in the simpler cases, this spring having been padded, is merely to be carefully and smoothly strapped on the leg in the following manner: first of all, to prevent the possibility of slipping, we must take three strips of plaister,* one of which is long enough to encircle the thigh, another the knee, a third the ankle, and in each of them a slit is cut lengthwise, exactly as long as the steel is broad; one of them encloses the splint at either end, and one of them at the middle. The pin must be kept in the hole near the pivot, the splint bent in the clamp to the proper arc (a little more bent than the abnormal curve of the leg), a proper pad is to be placed between the skin and the steel; an assistant holds the clamp and the spring in the proper position, while the surgeon first tightly encircles the limb with the three strips of plaister, and then straps up the leg carefully and smoothly. The foot must, of course, be included, otherwise it would swell.

* Empl. resinæ, spread on stout twilled calico.

The whole should also be bandaged. The clamp is then to be removed, and the pin which can easily be left uncovered by any plaister, must be taken out to give the hinge its liberty.

FIG. XIX.



THE APPARATUS FOR CROOKED LEGS.

Above is the spring, with plaister split, and fitted upon it. Below is the clamp holding the spring in a crooked position. The pin which keeps the hinge straight is shown as being just removed from the hole, whose position is also indicated.

It happens, however, that most patients require more careful arrangements, which vary in different cases. The rickety patient, *i.e.*, one with curved, not angularly bent limbs, also the patient with bow legs, must have something to modify the strain of the

plaister upon the inner side of the limb, more particularly upon the upper part of the thigh. Children thus affected have very soft, flabby thighs, and the utmost care in strapping will not prevent the edge of the plaister cutting the skin. The mode, which I adopt to obviate this evil, is to mould on the inner side of the limb a couple of rather thin leather splints, one above and one below the knee; these, when dry and properly padded, must be included in the strapping that encircles the part and attaches the spring. If the child's thigh be very fat and soft, a roll of flesh is apt to hang over the upper edge of the dressing; it is therefore better to let that end of the leather splint, bent somewhat outwards, project beyond the strapping, and to order the nurse to apply a little fresh cotton-wool or wadding, and to powder the thigh every night and morning. Again, the only part of the knee, which I find likely to excoriate is at the back over the inner hamstring; a little prolongation of the upper leather splint downward may be made perfectly to protect this part, and at the same

time not to interfere with the movement of the joint.

The above methods of adapting the splint are, I believe, the best possible in cases of the rachitic knock-knee, and the same leather splintage may also be used (is, indeed, quite as essential) in cases of bow legs, when the spring being applied to the outer side—*i.e.*, to the convex part of the limb—must of course be bent in the opposite direction.

The angular knock-knee is best treated with another arrangement of the spring; for, as in the rickety cases we require the pressure to be exerted pretty uniformly over the whole length of the limb, so in these latter the force should chiefly expend itself in the neighbourhood of the knee. My method of carrying out this object is the following: at either end of each half of the spring a hole is bored, which permits the passage of a screw with a broad flat head, and a nut or a female screw to fit. These four holes and screws are for the purpose of fastening upon the spring leather splints of far greater breadth, in the following way: two pieces of leather are to

be moulded, by means of hot water with a little vinegar, to the outside of the thigh and of the leg, leaving between them an interval of an inch or more (according to the size of the patient) at the knee. They are then to be removed and placed upon a table in a straight line, and with the same interval between them; through the holes in the steel marks are to be made upon the leather as guides to the places for boring through the splints, so as to admit the screws above described to pass through both leather and steel. The flat thin head of the screws must be kept on the inside, *i.e.*, next the leather; the nut must be fastened outside, sufficiently tight to join the two materials into one splint, which will be so broad as not to cut the skin; but which will, nevertheless, make upon the morbid bend of the limb considerable pressure, chiefly concentrated by the restraining influence of the leather on the neighbourhood of the knee. These splints fit also so accurately, that as long as the faulty angle in the leg remains, it is scarcely possible that they should turn round upon the limb; never-

theless, and for more security, I always, before fastening on the splint, pass the spring through three pieces of split strapping, as described at p. 202. At the second time of dressing, the thigh and leg piece must be unscrewed at one end and split strips of plaister put on each half of the springs; in these instances it saves time and trouble to put two pieces on each spring, one near the upper, the other near the lower screw.

Even with this arrangement, fat and flabby-limbed children will frequently require that on the top and inside of the thigh a piece of thin leather should be placed; which generally need not be more than $1\frac{1}{2}$ or 2 inches broad. The above mode of arranging the splintage may occasionally be very usefully adapted to the application of these springs at the inner side of bow legs; a mode of use which is sometimes desirable, because one of the abnormal bends in the upper part of the femur sometimes refuses to yield, like the other curves, to the spring-power, while applied on the outside of the limb.

In whatever mode the spring be used, it

must be carefully strapped to the limb, for very much of its comfort will depend upon smooth and even strapping, also on perfect and judicious padding. When, however, the surgeon has satisfied himself that the whole is properly arranged, he should first remove the little pin from the hole in the splint, and then displace the clamp. As this latter is freed, the limb assumes easily and without pain a very much straighter form; so that those unused to such cases are often surprised to see so great a change produced by so small a force. Before letting his patient go, the surgeon should grasp the thigh and leg, together with the splint, and bend the knee, so as to assure himself that the action of the hinge is free. The plaister will remain on from ten to twenty days; when it gets loose the limb should be put into warm water; the whole application will then come off with ease, and the skin must be rubbed with the hand, protected by a little flour or other innocuous powder. When next the mother or nurse brings the child to the surgeon, she will probably volunteer, that the child walks

much better with the splints on, and is less fatigued than without them. This is not to be wondered at, for the splint forms an efficient support to the leg, while it allows the knee to bend, and all the time keeps up a constant active effort towards placing the limb in a normal position. After a few times dressing, the limb will be very evidently straighter and stronger; so that when the child stands, he does not require to keep the knees together for mutual support.

These appliances, extremely troublesome as they are to the surgeon, are the only ones which I find applicable to young children; but for older persons—people from the age of six upwards—the method is not so advantageous. I have, therefore, since this work was first edited, devised another method of applying spring-force by a simple mechanism, which I will endeavour to describe, although the photograph (Plate xxvii.) will give a better idea of the appliance than any verbal description. The instrument consists of two metal splints, moulded to the outer side of the thigh and of the leg respectively. To

these is attached a spring, by means of a pivot sliding up and down in a groove or a slit cut in each splint; but a screw-nut permits these pivots to be fixed, as far as their sliding action is concerned. The spring itself is double, having a hinge in its middle which corresponds to the bend of the knee-joint. This spring is of a circular form, so that when the instrument is not *in situ*, the inside or concave surfaces of both splints come together. When these are drawn apart, and the instrument fastened upon the limb by webbing straps, the spring curves outward from the thigh to the leg in the form of a bow. In order to obtain the greatest value from the spring, a buckskin cap, shaped to the inside of the knee is attached to the spring, both above and below the hinge, by straps in front and behind the knee. These straps pulled by buckles which they carry, to desirable tightness, of course, pull the spring nearer to the knee-joint.

Thus the spring exercises force upon the three parts of the limb; it presses inwards upon the middle or upper third of the thigh,

PLATE XXVI.

PLATE XXVII.

PLATE XXVIII.

To face page 210.

DEFORMITIES OF THE LEG.

according to the place where we fix the pivot; also in the same direction on the leg at any spot we may choose, while the knee is drawn outwards by means of the cap affixed to its inner side. Of course, I need hardly point out that these are the very directions and places in which we should apply force if we were endeavouring to straighten the limb with the hands; nor need I explain, that the hinge in the spring enables the patient to bend the knee with perfect ease, and without interrupting for a moment the application of power.

The splint may be worn outside the drawers and stockings; also, it should be said, that a buckle is sewn to the upper part of the thigh splint, and a strap from the patient's stays passed through it, so as to prevent any slight tendency to slide downwards. The instrument is said by my patients to be very comfortable, and has in my hands been quite successful. The effect of a month's wear is seen at plates xxvi. and xxvii. The patient, fourteen years old, could walk much better, and even run. The instrument weighed a little more than a pound.

Case XVIII.

Curved Knock-knee. — Mary H——, aged 6, was brought to me at the Charing Cross Hospital, May 26, 1862, with weakness of the legs.

She was placed upon the table, and her dress being lifted, showed considerable deformity of the limbs. The double curves in the thigh and leg were strongly marked; the knees were kept together for mutual support. These conditions caused the outline of the two thighs together to look at their upper part broader, at their lower narrower than normal; while the outline of both shins is reversed, namely, narrow above, broad below. The child had also what are called "calf-knees," *i.e.*, the joints allowed too much extension, they "bent back;" such malposture frequently, but not invariably, accompanies a curved, and therefore a flexible, condition of the bones.

I cut out in paper carefully measured patterns for hinged splints, as described at p. 203, giving the gauge as No. 10,* and arranged that the child should be brought back again when the appliances were ready. In the mean time she was ordered to take the following three times a day.

℞ Ferri potassio-tartratis, gr. v.
Potassii iodidi, gr. iij.
Aquæ menthæ pip., ʒj. M.

* The reader should understand that the wire gauge and plate gauge are not only different but absolutely contrary; in the former the higher numbers are the smaller sizes; in the latter, No. 1 is the smaller size, No. 24, I believe, the largest. I have always used for these springs either 7, 8, 9, or 10.

4th June.—The child was brought back again, and the splints having in the meanwhile been finished, were carefully applied.

13th June.—The little girl's mother said that the child had been walking better, but for a day or two past has been complaining a little, in fact the right splint seemed to hurt her somewhat over the malleolus. A small hole was carefully cut in the strapping near the edge of the splint, and sufficient cotton wool was stuffed in under the spring, with the blunt end of a probe; this expedient seemed entirely to relieve the pain.

16th July.—The child's limb has been dressed once between the two last dates; it is much straighter, and the child walks greatly better.

17th Sept.—It does not appear worth while to follow the details of gradual alterations in this case; the child's gait and strength improved by degrees, and after the above date she ceased to attend.

Case XIX.

Anna R—, aged 5, was brought to me November 26th, 1861, with crooked legs of the curved description. The child was very fat and rather flabby, having soft flesh, and a good deal of it. I had previously been baffled by this condition of body, and had resorted to many expedients to enable such patients to continue wearing the splints. I resolved in this case to commence at once by protecting the child's flesh as much as possible against being rubbed by the plaister. For this purpose I moulded a piece of thin leather on the inside of the thigh, and another on the leg; the former was cut at

its lower end, so that the back portion descended lower down than the front, and protected the skin over the inner hamstring. The leg piece was cut at its upper part in a contrary direction, so that a projecting piece in front passed above the nether portions of the upper splint. Thus, though no continuity of leather splintage could obstruct the movements of the knee, the inner part of that joint was entirely protected against the plaister.

3rd Dec.—This arrangement, together with the longer splints that had been already made according to my pattern, I strapped on the limb at the above date.

13th Dec.—The child was said to have been very comfortable, and to have walked much better. The strapping was removed the day before, and the child's legs well washed both then and on the above named day; the apparatus re-applied.

11th Feb., 1862.—It is scarcely advisable to follow day by day the gradual improvement of this case; by the above date the child was able to walk very much better, and the limbs had very considerably improved in shape. Even without the splints the power of walking was much increased, and there was far less of the awkward waddling which had before so distressed the parents. I re-applied the apparatus as before.

15th April.—The improvement in shape and power of the child's legs has been gradual but constant. At the above date, the limbs were so nearly straight that an acute eye was required to detect any lack of symmetry; the child's gait was very good—a little feeble perhaps, but without waddling. This is the most rapid case

of the sort I have had; the local treatment had been so managed as to produce no abrasion or soreness of the skin. The general health had been improved by various tonic medicines, such as iron, quinine, cod-liver oil, &c., alternately exhibited.

Case XX.

George M——, aged 4 years and 8 months, was brought to me at the Charing Cross Hospital, February 3rd, 1862, with crooked legs. The boy was very weakly; his legs were thin, and when he was placed on the table and the clothes lifted, the limbs were found to have a very sharp curve about the knee. This was much more marked in the left than in the right limb. Both thighs were thin, and the flesh was very soft; by that expression it is not intended to designate the skin and the subcutaneous tissue merely, but the whole mass surrounding the bone. The inner side of the thigh was remarkably deficient in bulk and firmness, a condition which would point to want of power in the adductor mass, whence perhaps some part of the deformity. I cut out patterns in paper for a pair of steel splints, to be made of No. 10 gauge; that is, they were to be thick springs for so small a child; but then only one and a quarter inch broad. In each half of the spring there were holes above and below, each provided with a flat-headed screw and nut.

2nd March.—The splints having been made, the child came to have them applied. First two pieces of leather about one-sixth or one-eighth inch thick were cut, so that they would respectively cover, when moulded,

about one-quarter of the circumference on the outside of the thigh and of the leg, the two together clothing the whole length of the limb, except the knee, from hip to ankle; much thinner leather was cut, similarly to protect an equal amount of surface on the inner side of the limb. These four pieces having been steeped in hot water, were bandaged in their proper situations on the thighs and legs, so that they moulded themselves to fit their surfaces accurately. These splints being removed, the outside ones were placed on the table in a straight direction, leaving, however, between their proximate ends the same interval as separated them when *in situ*; —the spring splint was then placed upon the leather, and through the holes in the former pencil marks were made on the latter, as guides for boring holes, through which the screws passed, and fixed the leather and the steel together, making them as it were into one splint.* The arrangement of split strips of plaister according to the plan described at p. 206, was then carried into effect, and the whole, carefully padded, was strapped on each limb.

It is to be observed, that in this form of appliance, the splintage covers two separate quarters of the circumference of the limb at any given part; thus there remain two quarters, one in front, the other at the back, for the adherence of the plaister. This amount of skin surface is generally quite sufficient, but if it be thought desir-

* These splints and appendages I made myself, as this was the first case which I had thus treated, and I desired to arrange everything rightly; the method of arrangement being once fixed, an instrument-maker can fashion the whole apparatus for any other cases according to given directions and patterns.

able to secure more room, the breadth of the inner leather may be diminished.

28th March.—The splintage had fully answered the purposes expected of it; there was no excoriation, and the child had been quite comfortable, and walking better.

3rd October.—The improvement throughout this case had been very slow; at one time, moreover, the splints had to be discontinued for six weeks or more, on account of an attack of measles. However, the limbs were at the above date quite straight, or at least so nearly so that it was deemed unnecessary to continue the local appliances further. The general treatment had been of the tonic and nutrient kind.

Case XXI.

Eliza S——, aged 7, was brought to me at the Charing Cross Hospital, with bow-legs, March 28th, 1862. The child is a strong-looking little creature, broad-chested, with a fine colour, and round cheeks; but the legs are terribly crooked, so much so that when she stands the distance between the two knees is nearly as great as the breadth of the haunch from hip to hip. I carefully cut paper patterns, that the mother might order some steel-hinged splints, and at the same time I directed that leather should be moulded to the inner side of the leg and thigh, as described at p. 204, and in Case xix.

9th June.—The splints, &c., were carefully strapped on the limb.

29th August.—The improvement in this case was at

first very slow; but the treatment has been steadily persevered in, the apparatus being re-applied about every fortnight. For some reason that I cannot comprehend, the deformity began, about three months previous to the above date, to yield more rapidly, and at that date the limbs were very fairly straight, indeed the thighs were so little curved, that it appeared to me unadvisable to continue with the long-hinged splint; but as there was still an awkward bend outward near both upper and lower epiphysal junctions of the tibia, I applied a short tibial splint below.

28th November.—The same industrious method has been employed with the short as with the long splint. The child's legs appeared at this date so nearly normal that further splintage was considered unadvisable.

CHAPTER XIV.

DEFORMITIES OF THE LEG.

Crooked Shins.

The peculiar unsightly shins of rickety children are occasionally unaccompanied by knock-knees or bow-legs; but more frequently are coincident with only a slight degree of either deformity. The conformation generally, however, of the skeleton, namely, large joint ends, exaggerated curves in all the long bones, and debility in the whole system, is such as indicates the morbid condition. When the general disorder can be overcome while the subject is still far below puberty, there is every possibility that a slight degree of curvature in the shins will disappear with the growth of the body; but more developed curves will not do so,

and will remain when their morbid cause has disappeared with advanced age. The very ugly form of the leg thus produced is frequently a cause of great annoyance to the adolescent and adult, as may be gathered from a case related by John Bell, of a dancing master, who caused his shins to be filed down by a blacksmith, undergoing agony at the time, and subsequent torture from necrosis and exfoliations. Scarcely, however, had the wound healed, when observing that his legs were not as straight as could be desired, he applied for a repetition of the smith's art. Few people would have the courage of this dancing-master; but the story shows how great may be the mental trouble produced by such distortion. Parents should be very careful not to allow their children to grow up with a deformity, which a painless treatment may remedy; but which in after life may very probably be a cause of much mental distress.

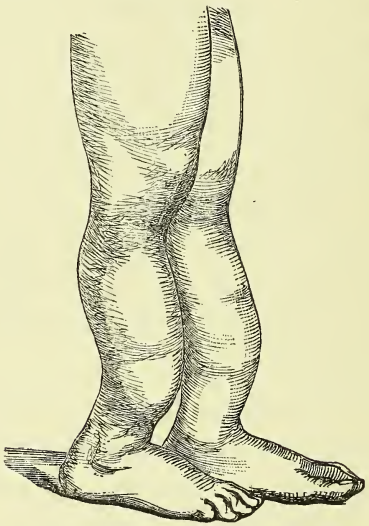
The mode in which the tibia bends is rather peculiar; its greatest prominence is at the junction of the middle and lower third.

The whole length of the diaphysis above this point is nearly straight; but at that place there is a bend so sharp that it is almost an angle, and of course the more advanced the case the sharper is the curve. Now, if we take this bend as the starting-point of our description, we may say that the shaft of the bone above and below slopes from that angle backward to an equal amount, so that the lower stands perpendicularly under the upper end of the bone; and it follows that the inclination of the upper part is only half that of the lower. Since, moreover, the tibia is jointed to the femur above, a compensating curve is necessitated at the very incomplete epiphysal junction.

The rapidity of the backward slope at the lower part of the bone causes the profile outline at the back of the limb to run in the same line as the normal projection of the calcaneum; thus the heel looks as though it began one-third up the leg. Moreover, the lower articular surface of the tibia faces backwards; and thus the ankle must be constantly flexed, in order to keep, while stand-

ing, the limb perpendicular on the ground; hence in these cases there is a peculiar secondary deformity of the astragalus, namely, an over acute angle at the neck. All these patients have very flat feet, partly produced

FIG. XX.



CROOKED SHINS FROM RICKETS.

The peculiar curves of the tibia and the flatness of the feet are characteristic.

by the above change, partly by approximation of the origin, and insertion of, therefore want of action in the anterior tibial muscle.

The method I have devised for the cure of the deformity, is an adaptation of my spring splint to the part in question. The steel spring should be about an inch or an inch and a half wide, plate-gauge from number 7 to number 10, according to the power required, and of course it will be remembered, that the shorter the spring and greater its bend, the more will be its force. For those cases in which the bone is peculiarly protuberant at the junction of the middle and lower thirds, it will be as well that the splint be of a trapezoid shape—*i.e.*, that it become narrower from above downwards: this arrangement will cause it chiefly to bend a certain distance below the middle, proportional to the amount of difference between the breadth of the two ends; thus the spring may be mathematically made to curve so as to fit exactly the shape of the bone. Previously, however, to bending the splint, two pieces of strapping must be slit sufficiently to embrace the iron—one above, one below; and then the spring may be set in the clamp, at the proper curve. On the other side of

the limb a rather thin leather splint must be moulded, two sufficient pads are to be provided, and while an assistant holds the clamp and spring in its place, the whole is to be carefully and smoothly strapped; of course the foot is to be included, and indeed must be bound rather tighter than the rest, since the spring will keep upon the plaister on the leg a considerable strain.

At the first dressing, the plaister must not be too tightly applied, or pain and sundry other inconveniences will be caused; but in a little time, if both the leather and the splint be nicely padded, the whole may be fastened with very considerable firmness.

The effects of the application soon become visible in a decided diminution of the curve in the limb, and in greater firmness of the gait. The length of time, during which the treatment must be continued, depends altogether on the age of the patient and the amount of the deformity. If the strapping and padding be carefully applied, if care be taken to keep the leather splint of a perfect fit, and if the general health of the patient be

attended to, the benefit of the spring force will be very soon apparent.

Case XXII.

Martha H——, aged 5, was brought to me with extremely crooked shins, 9th August, 1861. The child had large joint ends to all the long bones, and the peculiar formation of skull, which is significant of rickets. The weak condition of circulation and the pallor of the child prevented my adapting a splint at once. Tonics were given; cold bathing, instead of washing in hot water, and a nutritious diet were prescribed.

2nd September.—The child being stronger and less pallid, I had previously let some splints (gauge 7) be made; they were strapped on with gentle pressure this day.

7th October.—I, having been in the country, had not seen this child since the first application of the splint. The mother told me that she walked greatly better, and that the legs appeared straighter. I could not pretend to carry in my mind the outlines of her limbs, among many carefully-observed deformities; and could not assert that there was or was not improvement. The splint re-applied.

30th December.—After such an interval, I could without danger, affirm that the shins were very much straighter. The child's health was very considerably improved: this was in part to be attributed to the tonics and general regimen, in part to her being able to walk better and take more healthy exercise. I now had the splints bent and re-tempered, by which device I ob-

tained additional power; for when, by means of the clamp, they were bent to fit the shin into a curve contrary to that in which the steel had been tempered, the force of the spring was, of course, increased by the difference between the straight line and the permanent curve of the metal.*

8th January, 1862.—The increased power of the splint has caused the plaister, where it is strained most tightly by the spring action, to gall the skin on the back and inner side of the leg. The application of the splints was discontinued for some days, during which the skin again became sound.

20th January.—During the last twelve days, the skin has been aided to heal and harden by means of an astringent lotion. Before re-application of the splints, a piece of thin leather was moulded on the leg at the back. The result of thus increasing the power of the spring without modifying the other parts of the apparatus, showed me that it would in all cases be advantageous to protect by leather the skin exposed to the greatest power of the splint. I have not neglected the precaution since.

16th May.—Not quite three months previous to this date there occurred a marked improvement in the shape of the child's legs. The splints have in the meantime been constantly applied—the renewal occurring about every fortnight, or twice in five weeks. From the above date it was exactly nine months since the child came

* This plan is very useful when the bone becomes so nearly normal in shape that an ordinary straight splint would exert no force, but when, nevertheless, it may be desired to continue treatment.

under my care. The treatment has certainly been very tedious and troublesome, and at times almost disheartening; but the mother has always been pleased with the greater ease with which the child could walk, and at this date, as the legs were nearly or quite straight, I myself in discharging the patient from treatment, felt satisfied with the result.

Case XXIII.

A. M—, aged 9.—The case of this boy is very similar to that just narrated; but, in consequence of certain differences, it will be described in relationship to Case xxii. In the first place, the patient, who came to me March 3rd, 1862, was older, and the health did not appear so disordered: on the other hand, the bones were less crooked, but naturally were larger, and therefore probably stronger; and, particularly at the point of greatest curvature, they were thickened by deposit of additional substance behind, partially filling up the depressed angle. This is a very constant condition in rickets.

I ordered splints to be made of No. 9 gauge, directed that leather should be moulded to the back of the limb; and when these preparations were complete, the splint, being duly bent in the clamp, &c., was carefully, not too tightly, strapped on the limb. This case continued in much the same way as the last, but not so long: in five months I had the splint bent and re-tempered, and in another two months I could discharge the boy from care.

It is not consistent with the purpose of this

book to enter into the treatment desirable in distortions of the joints, arising from disease or other causes. The principles, whereon such treatment is founded, are explained in my work on "Diseases of the Joints." Increased practice and experience, however, has led me to adopt certain expedients, which, as above stated, cannot be fully described in this volume. It will not be, however, out of place to observe that the more I see of anchylosed joints, and of our powers of restoring them, the more am I persuaded that tenotomy or myotomy are very often much abused, and are, in point of fact, very rarely needed.

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